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NOTES AND NEW DISTRIBUTION RECORDS ON THE MOSQUITOES OF NORTH CAROLINA

By H. F. Schoof[1] and D. F. Ashton,[2] *North Carolina State Board of Health*

The operation of malaria control programs in North Carolina from 1937 to 1943 has necessitated extensive entomological observations. These observations, although chiefly concerned with anopheline material, have contributed greatly to the general knowledge of the mosquito fauna of the state. It is the purpose of this paper to present these data for those species which are relatively rare or hitherto unknown in North Carolina.

The material included applies chiefly to the east-central and eastern portion of the state; in general to that half east of Charlotte.

King *et al.* (1943) list new distribution records for six species in North Carolina: *Aedes trivittatus* (Coq.), *Anopheles atropos* (D. and K.), *Anopheles crucians georgianus* King, *Psorophora varipes* (Coq.), *Psorophora horrida* D. and K., and *Uranotaenia sapphirina* (O.S.). Additional records on these species, excepting *Aedes trivittatus* (Coq.), are given herein.

The various types of collections are abbreviated in the records as follows: (AS) = animal shelter; (B) = biting; (C) = culvert; (CS) = cast skin; (L) = larval; (LT) = light trap; (P) = privy; (RA) = reared adult; (RB) = resting in barrel; (RW) = resting in woods; (UB) = under bridge. This collection designation precedes the number of specimens taken and the date in each listing. Absence of this abbreviation indicates that the type is unknown.

Anopheles atropos D. and K.

This species was first taken in North Carolina on Roanoke Island by C. L. White in 1934. Since then it has been collected in the coastal areas as far south as Wilmington, with the majority of adult captures being in light traps. In 1942 larval and adult specimens were collected in the salt marshes off Tar Landing the adults biting in the bright sunlight.

In addition to the localities given below, King *et al.* (1943) list this species as being taken at Wilmington.

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HOLLY RIDGE: (LT) 1 ♀, Sept. 6, 1942. JACKSONVILLE: (LT) 1 ♀, Sept. 19, 1942. MOREHEAD CITY: (LT) 2 ♀ ♀, Aug. 8, 25, 1942; (LT) 1 ♂, 41 ♀ ♀, Sept. 8–11, 15, 19, 1942, L. A. Whitford. ROANOKE ISLAND: 2 ♀ ♀, late October, 1934; (AS) 1 ♀, Nov. 24, 1934, C. L. White. TAR LANDING: (L) 2, (B) 1 ♀, Sept. 10, 1942, HFS, DFA.

Anopheles barberi Coq.

Anopheles barberi is an infrequent species that has been taken in widely separated localities in the state. Howard *et al.* (1912–17) record it from Tryon.

ASHEVILLE: (P) 2 ♂ ♂, Aug. 4, 25, 1943, HFS. CHERRY POINT: (UB) 1 ♂, Sept. 14, 1942, L. A. Whitford. LAURINBURG: (AS) 1 ♀, July 2, 1943, S. L. Suib. MANCHESTER: (AS) 1 ♂, Sept. 10, 1942, HFS. MAXTON: (AS) 1 ♂, Oct. 12, 1943, S. L. Suib. PINEVILLE: (UB) 1 ♂, Aug. 23, 1943, HFS.

Anopheles crucians bradleyi King

Larval specimens of this subspecies have been taken at two coastal localities.

NEW BERN: (L) 1, Aug. 28, 1942; (L) 5, Aug. 10, 23, 1943. TAR LANDING: (L) 1 (CS) 1, Sept. 10, 1942, HFS, DFA.

Anopheles crucians georgianus King

Anopheles crucians georgianus was taken in several localities in the state in 1942, but most frequently in the vicinity of Fort Bragg. One typical breeding area, a broad seepage slope, containing sundew, pitcher plants (*Sarracenia purpurea* and *S. flava*), and Venus fly traps along its edges, was covered with numerous scattered, shallow puddles in which both *A. crucians georgianus* and *A. crucians crucians* were breeding abundantly. Muddying the water and removal of the larvae by pipette proved the most satisfactory method of collection. Larvae were also taken in a farm ditch near Fayetteville.

Although *A. crucians crucians* is prevalent in the state throughout the spring and summer, *A. crucians georgianus* up to this date has not been taken prior to the month of June.

King *et al.* (1943) list *A. crucians georgianus* as also occurring at Monroe, N. C.

FAYETTEVILLE: (L) 2, Sept. 3, 1942, T. B. Mitchell. FORT BRAGG: (L) 25, July 10, 15, 23, 24, 1942; (L) 14, Aug. 5, 1942; (L) 8, Sept. 4, 9, 16, 1942, T. B. Mitchell; (RA) 2 ♀ ♀, Sept. 9, 1942, HFS, DFA. GOLDSBORO: (L) 3, Sept. 3, 1943, L. A. Whitford. HAMLET: (L) 12, Aug. 27, 30, 1943; (L) 15, Sept. 2, 6, 9, 10, 1943, S. L. Suib.

Anopheles walkeri (Theob.)

This anopheline was taken for the first time in North Carolina in 1943 at Chub Lake, Person County. Larvae were breeding in areas heavily vegetated with several species of marsh smartweed, *Persicaria portoricensis, P. muhlenbergia, P. hydropiperoides* and golden club, *Orontium aquaticum*. *Anopheles walkeri* was not abundant, only four larvae being found in the ninety-eight specimens collected. The remaining larvae were primarily *A. quadrimaculatus* and *A.*

punctipennis, together with a few *A. crucians crucians*. One adult *A. walkeri* was taken in a mule shed near the lake while two other females were reared from pupae.

CHUB LAKE, PERSON COUNTY: (AS) 1 ♀, (RA) 2 ♀ ♀, (L) 4, Sept. 22, 1943, HFS.

Aedes atropalpus (Coq.)

Larvae of this species have been taken in rock pools at both localities given below. At Chimney Rock *A. atropalpus* was abundant, the adults being extremely annoying at dusk.

Brimley (1938) records this species from Blowing Rock and Mecklenburg County.

CHIMNEY ROCK: (L) 3, (B) (RA) 2 ♂ ♂, 6 ♀ ♀, Sept. 3, 1939, DFA. MOUNT GILEAD (Eurie Dam): (L) 6, Aug. 30, 1938, DFA.

Aedes dupreei (Coq.)

EDGECOMBE COUNTY: 1 ♂, Aug. 1, 1935; 2 ♀ ♀, June 9, 1938; (B) 1 ♀, July 29, 1941; (B) 5 ♀ ♀, (Conetoe Creek), Aug. 12, 1941, DFA. ELIZABETH CITY: (L) 2, May 13, 1943, S. C. Schell. WILMINGTON: (LT) 1 ♀, Aug. 5, 1942.

Aedes infirmatus D. and K.

This species has seldom been collected in the state, only two recent records being on file. Dyar (1922) records *A. infirmatus* from Charlotte.

MOREHEAD CITY: (AS) 2 ♀ ♀, Nov. 5, 1942, HFS. WILMINGTON: (L) 1, June 16, 1942.

Aedes fulvus pallens Ross

Ross (1943) points out that the species heretofore called "*A. bimaculatus*" in the southeastern states is not the true *bimaculatus* which ranges from central Texas to El Salvador. He therefore describes the "*bimaculatus*" of the southeastern states as a new subspecies of *A. fulvus*, *fulvus pallens*.

The specimens from which records have been taken agree with the characters given by Ross (1943) for the new subspecies.

Barret (1919) records "*bimaculatus*" from Charlotte and Brimley (1938) lists it from Wilmington. The specimen from which Brimley's record was taken has been examined and is *A. fulvus pallens*.

S. C. Schell has collected adults of this subspecies at Goldsboro on blades of tall grass near the edge of clear pools of water. He reports that they appear to be rather weak, slow fliers, being readily captured by hand.

FAYETTEVILLE: (LT) 1 ♂, 1 ♀, Sept. 2, 1942. GOLDSBORO: 1 ♂, 2 ♀ ♀, August, 1942, S. C. Schell. ROCKY MOUNT: (RW) 1 ♀, July 30, 1941, DFA.

Aedes mitchellae Dyar

Larvae of this species have been taken in newly flooded grassy areas. In one instance the flooding occurred in an upland pocosin, the water being crystal clear

while in the other the inundation resulted from the backing up of a coastal creek, this water being extremely muddy.

Brimley (1938) lists *A. mitchellae* as being taken in Wilmington in December and King *et al.* (1942) record it from Holly Ridge in April.

ELIZABETH CITY: (L) 2, May 23, 1942, HFS. JACKSONVILLE: (LT) 1 ♀, Sept. 25, 1942. LUMBERTON: 2 ♀ ♀, May 20, 1913, H. P. Barret; (B) 1 ♀, April 11, 1939, DFA. MARIETTA: (L) 3, Aug. 10, 1939, DFA. WILMINGTON: (LT) 1 ♀, Aug. 26, 1942.

Aedes sticticus (Meig.)

Aedes sticticus occurs in sufficient numbers in early spring at Kelly to be extremely bothersome along the wooded floodplain area of the Cape Fear River. During the summer months it disappears, being replaced by *Aedes atlanticus* and *Psorophora ferox*.

KELLY: (B) 6 ♀ ♀, Mar. 23, 1939; (B) 16 ♀ ♀, May 9, 1939, DFA. MARIETTA: (UB) 1 ♀, April 18, 1939, DFA.

Aedes thibaulti D. and K.

This species is not common in the state, but has been found pestiferous in certain localities. The larvae have been taken from rock holes in a stream bed at Lake Tillery.

EDGECOMBE COUNTY: (RW) 5 ♂♂, (B) 2 ♀ ♀, April 27, 1939, DFA. ELIZABETH CITY: (AS) 1 ♀, June 9, 1942, HFS. JOHNSTON COUNTY: (RB) 1 ♂, July 12, 1938, DFA. KELLY: (R) 1 ♂, (B) 1 ♀, May 14, 1940, DFA. LAKE TILLERY: (RA) 4 ♂♂, 7 ♀ ♀, July 25, 1940, DFA. MOSS NECK: 1 ♀, May 17, 1938, DFA. ROBESON COUNTY: 1 ♀, June 17, 1938; (RW) 1 ♂, 1 ♀, April 13, 1938, DFA.

Aedes tormentor D. and K.

The only specimen ever taken of this species in North Carolina is one larva collected by L. A. Whitford at Cherry Point.

CHERRY POINT: (L) 1, Aug. 18, 1942, LAW.

Psorophora cyanescens (Coq.)

This species has been collected only at Swannanoa where a female was taken biting in the bright sunlight in an open field.

SWANNANOA: (B) 1 ♀, Aug. 26, 1943, HFS.

Psorophora discolor (Coq.)

The larvae of this species were taken with *P. ciliata* in small, muddy pools with grassy edges at Monroe. On collection they feigned death and rolled about in the bottom of the dipper. As a consequence their detection in the muddy water was difficult.

MONROE: (RA) 2 ♂♂, 4 ♀ ♀, Aug. 26, 1942; (L) 1, July 15, 1942; (L) 26, Aug. 26, 1942, S. C. Schell, HFS, DFA.

Psorophora horrida (D. and K.)

King *et al.* (1943) list this species from Fort Bragg and Camp Sutton. These records, with those below, indicate a wide range for *P. horrida* in the eastern half of the state.

CAMP BUTNER: (B) 1 ♀, July 22, 1942, P. J. Darlington. LOUISBURG: (B) 1 ♀, Sept. 22, 1937, DFA.

Psorophora howardii (Coq.)

This species is present over the eastern half of the state, but is encountered much less frequently than *P. ciliata*.

Dyar (1922) records *P. howardii* from Charlotte, and Brimley (1938) lists it from Wilmington.

EDGECOMBE COUNTY: 1 ♂, 1 ♀, May 23, 1938, DFA. ELIZABETH CITY: (RA) 2 ♀ ♀, Aug. 8, 1942. FAYETTEVILLE: 1 ♀, May 18, 1942. MOUNT GILEAD: (RA) 1 ♀, July 25, 1940, DFA. NEW BERN: (RA) 2 ♀ ♀, Aug. 1942. RALEIGH: 1 ♀, July 7, 1941, DFA.

Psorophora varipes (Coq.)

Psorophora varipes has been taken at five localities in the state and although not encountered frequently, usually is abundant and extremely pestiferous wherever found.

King *et al.* (1943) record this species from Fort Bragg.

EDGECOMBE COUNTY: (B) 10 ♀ ♀, July 29, 1941, DFA. GOLDSBORO: (B) 4 ♀ ♀, July 20, 1943, R. F. Fritz, HFS. JOHNSTON COUNTY: (B) 1 ♀, Sept. 13, 1939, DFA. MOUNT GILEAD: 12 ♀ ♀, July 25, 1940, DFA. ROCKY MOUNT: (B) 1 ♀, July 30, 1941, DFA.

Culiseta inornata (Will.)

Culiseta inornata was taken in the winter of 1942–43 at two localities in the state. At Goldsboro on December 23 one larva was found in a pasture pond containing a predominance of the common juncus. The larvae of *Culex salinarius* were numerous at this date. Three weeks later the same breeding area showed abundant larvae and pupae of *C. inornata*. Subsequent inspection on February 1, however, revealed no larvae or pupae of this species and only a few of *Culex salinarius*.

T. L. Quay (in litt.) states that *C. inornata* was found at New River during the winter months of 1942–43. Dyar (1922) lists it from Wilmington and Brimley (1938) records it from Charlotte.

ELIZABETH CITY: (RA) 2 ♀ ♀, Feb. 20, 1943, S. C. Schell; (L) 1, Feb. 24, 1943, S. C. Schell. GOLDSBORO: (L) 1, Dec. 23, 1942, HFS, S. C. Schell; (L) 4, (RA) 2 ♂ ♂, 3 ♀ ♀, Jan. 15, 1943, S. C. Schell.

Culiseta melanura (Coq.)

King, Bradley and McNeel (1942 rev.) list this species as rare in the southeastern states, but it is quite common in the eastern and east-central portions of North Carolina. The adults have been collected in all types of shelters and in

light traps, being found more abundantly in the latter. Larval specimens, on the other hand, are seldom taken.

Light trap collections at Fayetteville, Fort Bragg, Wilmington, and Jacksonville from June to October 2, 1942, revealed that the peak of abundance occurred in late August and September. Out of 232 females, 95 per cent were captured in these two months, the total for each month being approximately equal. Adult catch station records in 1942 also indicate a spring prevalence, but the peak of abundance is much below that of the fall.

BLADEN COUNTY: 1 ♀, July 11, 1939, DFA. CAMP DAVIS: (LT) 2 ♀ ♀, June 28, 1942; (LT) 2 ♀ ♀, July 8, 1942. CHERRY POINT: (LT) 1 ♀, Aug. 7, 1942; (UB) 1 ♀, Dec. 3, 1942, HFS. COLUMBUS COUNTY: 2 ♂ ♂, Sept. 5, 1938, DFA. EDGECOMBE COUNTY: 2 ♀ ♀, Aug. 25, 1938, DFA; (L) 3, July 20, 1939, DFA; (UB) 1 ♀, May 23, 1940, DFA. ELIZABETH CITY: (AS) 2 ♀ ♀, June 11, 16, 1942, T. L. Quay; (AS) 1 ♂, July 9, 1942, TLQ; (AS) 4 ♀ ♀, (LT) 1 ♀, Aug. 13, 15, 18, 1942, TLQ; (AS) 3 ♀ ♀, Sept. 3, 26, 1942, TLQ; (AS) 2 ♀ ♀, Oct. 6, 1942, TLQ; (AS) 1 ♀, Nov. 30, 1942, HFS. FAYETTEVILLE: (LT) 4 ♀ ♀, Sept. 11, 12, 17, 1942; (L) 1, Sept. 25, 1942, HFS; (AS) (UB) (C) 3 ♀ ♀, Sept. 11, 29, 1942. FORT BRAGG: (AS) 1 ♂, 2 ♀ ♀, April 23, 1942; (LT) 1 ♂, 2 ♀ ♀, June 18, 19, 1942; (LT) 2 ♂ ♂, 7 ♀ ♀, July 22, 23, 29, 31, 1942; (LT) 1 ♂, 4 ♀ ♀, Aug. 1, 25, 1942; (LT) 1 ♂, 26 ♀ ♀, Sept. 3–5, 9–11, 16–19, 1942; (AS) 1 ♀, Oct. 15, 1942; (L) 2, Nov. 26, 1942, HFS; (L) 6, Jan. 26, 1943, HFS. GOLDSBORO: (AS) 2 ♀ ♀, Oct. 1, 18, 1942, S. C. Schell. JACKSONVILLE: (UB) 2 ♂ ♂, 2 ♀ ♀, April 27, 30, 1942; (UB) 2 ♂ ♂, (C) 3 ♀ ♀, May 5, 9, 27, 1942; (UB) 2 ♀ ♀, (LT) 1 ♂, 3 ♀ ♀, June 9, 13, 16, 18, 19, 1942; (P) 1 ♀, July 31, 1942; (LT) 4 ♀ ♀, Aug. 25, 27, 28, 1942; (LT) 3 ♂ ♂, 15 ♀ ♀, (C) 3 ♂ ♂, 1 ♀, Sept. 2–5, 8, 10, 15, 19, 22, 25, 1942; (LT) 2 ♀ ♀, (UB) 1 ♀, (AS) 1 ♀, Oct. 1, 22, 1942; (UB) 1 ♂, 2 ♀ ♀, Nov. 4, 1942. KITTY HAWK: 2 ♂ ♂, 5 ♀ ♀, Aug. 24, 1938, DFA. MARIETTA: (UB) 3 ♂ ♂, April 18, 1939, DFA. MAXTON: (AS) 1 ♀, Sept. 22, 1942, S. C. Schell. MOREHEAD CITY: (LT) 1 ♀, Aug. 28, 1942. MOSS NECK: 1 ♀, June 27, 1938, DFA. NEW BERN: (AS) 1 ♂, 1 ♀, May 4, 1942; (AS) 1 ♀, Aug. 11, 1942; (AS) 1 ♀, Sept. 1, 1942; (AS) 3 ♀ ♀, Oct. 19, 1942, HFS. NEW HANOVER COUNTY: 1 ♂, 1 ♀, May 5, 1938, DFA. PINEY GREEN: (LT) 3 ♀ ♀, Sept. 23, 24, 1942; (LT) 1 ♀, Oct. 2, 1942. PLYMOUTH: 4 ♂ ♂, 2 ♀ ♀, Aug. 8, 1940, DFA. WAYNE COUNTY: (UB) 1 ♂, 1 ♀, May 5, 1940, DFA. WHITE LAKE: (L) 3, July 12, 1939, DFA. WILMINGTON: (LT) 2 ♂ ♂, 92 ♀ ♀, Aug. 8, 13, 14, 26, 28, 29, 1942; (LT) 1 ♂, 64 ♀ ♀, Sept. 1, 2, 15–17, 22–25, 1942; (LT) 2 ♂ ♂, Oct. 2, 1942.

Orthopodomyia alba Baker

Orthopodomyia alba has been recorded from one southern state, Georgia, by Shields and Miles (1937). On September 18, 1942, larvae of this species together with those of *O. signifera* were taken at Manchester from an old carbide cannister which was sunken in the ground. The latter species greatly predominated. A second observation on October 16, indicated a similar population, but on November 17 no *O. alba* were present. A fourth visit on November 26 revealed that most of the water had been removed from the cannister and no larvae of either species were found.

Reeves (1941) in some observations on *O. signifera* states that "the character of hypodermal pigmentation given as pink or purple for *O. signifera* and lacking for *O. alba* has been found in California to depend entirely on larval diet." The author then describes experiments in which the color of the larvae changed from purple or pink to yellow or brown upon alteration of the diet from rose pink pigmented bacteria to yeast. It has been revealed (in litt.) that no *O. alba* were available for these experiments, and consequently the above quoted statement cannot be applied to that species. In addition the occurrence of the typical bluish-purple to brown larvae of *O. signifera* and the whitish larvae of *O. alba* together in same environment indicates that the larval diet has little, if anything to do with the absence of color in *O. alba*. Reeves (in litt.) has found cream colored specimens of *O. signifera* so it is probable that the purplish pigmentation of this species cannot always be relied upon as a diagnostic character.

The larvae of *O. alba* (15) and *O. signifera* (18) that were found in the carbide cannister have been examined closely by the writers in regard to the differentiating characters listed in tabular form by Baker (1936). In addition 33 larvae of *O. signifera* from other North Carolina localities have also been checked.

Of the 51 specimens of *O. signifera*, thirty-two had dorsal abdominal plates on segments 6–7–8, seventeen on segments 7–8 and two on segment 8. Because these dorsal plates are frequently absent on segments 6 and 7, it is evident that the presence of a plate on segment 8 is the only reliable plate characteristic which can be used in separating *O. signifera* from *O. alba*. In the latter species no dorsal abdominal plates occur on segments 6–7–8 so that this character is by far the most conspicuous means of differentiating the larvae of two species. Reeves (1941) has found similar variations in the occurrence of the dorsal plates on California specimens of *O. signifera*.

The number of the teeth in the anterior row of the comb on the eighth segment was found to vary from 11–17 in *O. alba* and 17–24 in *O. signifera*. Reeves (1941) records 13–22 teeth for *O. signifera* and Shields and Miles (1937) found as many as 18 teeth in specimens of *O. alba*. Because of overlapping it is apparent that the number of teeth cannot be relied upon as a criterion for the separation of the two species. The writers believe that a comparison of the relative lengths of the anterior and posterior rows of the comb teeth can be used as a differentiating character. In *O. alba* the posterior row is more than three-fourths (usually seven-eighths or equal to) the length of the anterior row, whereas in *O. signifera* the posterior row seldom exceeds one-half the length of the anterior one.

Of the remaining characters listed by Baker (1936) the following have been found to be excellent means for separating *O. alba* from *O. signifera:*

	O. alba	*O. signifera*
Transutural tuft	Multiple	single
Sub-basal tuft	conspicuous (7–11 branches)	inconspicuous (2–3 branches)
Sub-antennal tuft	prominent	minute
Ventral fusion of anal plate	incomplete	complete
Sub-siphonal tuft	3–5 hairs	5–12 hairs
Siphonal tuft	3–5 hairs	5–11 hairs

It has been revealed that the anal gills vary in the two species to such an extent that they are of little use as diagnostic structures.

Certain other characters such as the shape of siphon, color of head capsule, general hairy appearance, lateral hair tufts on first and second abdominal segments, and the ventral tufts of the sixth segment are, in general, reliable only when specimens of both species are available for comparison.

Although the larvae of *O. alba* and *O. signifera* are easy to distinguish, the adults frequently are difficult to separate. Reeves (1941) found the markings of *O. signifera* to vary toward those of *O. alba* in the majority of his California specimens. The writers have three adults of *O. alba* and these show the typical triangular patch of white scales on the second abdominal tergite. Seventeen specimens of *O. signifera*, on the other hand, exhibit on the second tergite the characteristic basal white band which is replaced apically by black scales. The remainder of the abdominal segments in *O. alba* have a whitish basal band but in *O. signifera* variations from basal, lateral white spots to basal bands are found.

MANCHESTER: (L) 15 (RA) 3 ♀ ♀, Sept. 18, 1942, S. C. Schell, HFS, DFA.

Culex peccator D. and K.

Dyar (1922) lists *C. peccator* from Rockingham, Charlotte, and Jacksonville.

The following records are all adult males and have been identified by examination of the male genitalia.

EDGECOMBE COUNTY: 2♂♂, Sept. 13, 1938; 5♂♂, Sept. 14, 1938, DFA. EUREKA: (UB) 1♂, Aug. 21, 1941, HFS. FAYETTEVILLE: (UB) 1♂, Sept. 2, 1942, T. B. Mitchell; (UB) 1♂, Sept. 9, 1943, HFS. MARIETTA: 1♂, May 18, 1938, DFA; (UB) 2♂♂, Nov. 5, 1941, DFA.

Culex pipiens L.

King *et al.* (1943) record *C. pipiens* from Lake Lure, Camp Butner, Camp Sutton, Fort Bragg, and Smithfield.

WHITAKERS: (RA) 3♂♂, (L) 3, Nov. 14, 1938, DFA.

Uranotaenia sapphirina (O.S.)

Although no records have been published for the occurrence of *U. sapphirina* in North Carolina prior to those of King *et al.* (1943), this species is common along the coastal areas and in the east-central portion of the state.

ASHEVILLE: (L) 6, Aug. 28, 1943, DFA, HFS. CAMP DAVIS: (LT) 46 ♀ ♀, June 14, 18, 29, 1942; (LT) 2♂♂, 127 ♀ ♀, July 2, 3, 5–9, 19, 1942; (LT) 2 ♀ ♀, Aug. 6, 9, 1942. CHERRY POINT: (LT) 1♂, 15 ♀ ♀, June 15–19, 22, 24, 1942; (LT) 51 ♀ ♀, July 7, 17, 25, 27–30, 1942. EDGECOMBE COUNTY: 1 ♀, Aug. 10, 1938, DFA. ELIZABETH CITY: (L) 15, June 25, 26, 1942; (L) 7, Sept. 12, 18, 1942. FAYETTEVILLE: (L) 3, April 30, 1942; (L) 5, Aug. 27, 1942; (LT) 3 ♀ ♀, Aug. 11, 14, 27, 1942; (LT) 2 ♀ ♀, Sept. 10, 12, 1942. FORT BRAGG: (L) 3, May 1, 4, 1942; (L) 5, June 13, 24, 29, 1942; (L) 7, July 3, 17, 1942; (LT) 1♂, 7 ♀ ♀, July 22, 24, 25, 30, 31, 1942; (LT) 3 ♀ ♀, Aug. 1, 22, 1942; (L) 5, Aug. 24, 1942; (L) 7, Sept. 5, 1942. GOLDSBORO: (L) 10, Sept. 22, 25, 1942. JACKSONVILLE:

(LT) 2♀ ♀, Aug. 4, 14, 1942. JOHNSTON COUNTY: 1♂, May 21, 1940, DFA. KITTY HAWK: (RW) 1♂, 3♀ ♀, Aug. 24, 1938, DFA. MAXTON: (L) 1, Aug. 20, 1942. MOREHEAD CITY: (LT) 2♀ ♀, June 15, 22, 1942; (L) 3, June 19, 1942. NEW BERN: (L) 5, Sept. 1, 4, 1942. OXFORD: (L) 5, Sept. 2, 1942. SOUTHPORT: (LT) 2♀ ♀, Oct. 26, 1943. WAYNE COUNTY: 1♀, May 8, 1942, DFA. WILMINGTON: (LT) 1♀, June 19, 1942; (LT) 1♂, 3♀ ♀, Aug. 16, 1942; (LT) 1♀, Sept. 23, 1942.

The following species can be considered of common occurrence in the state: *Aedes aegypti* (L), *A. atlanticus* D. and K., *A. canadensis* (Theob.), *A. sollicitans* (Walk.), and *A. taeniorhynchus* (Wied.), in coastal areas, *A. triseriatus* (Say), *A. vexans* (Meig.), *Anopheles quadrimaculatus* Say, *A. punctipennis* (Say), *A. crucians crucians* Wied., *Culex apicalis* Adams, *C. erraticus* D. and K., *C. quinquefasciatus* Say, *C. restuans* Theob., *C. salinarius* Coq., *Psorophora ciliata* (F.), *P. confinnis* (L.-Arr.), and *P. ferox* (Humb.).

In addition to these species there are several which although not rare occur too infrequently to be classed as common. Included in this category are: *Mansonia perturbans* (Walk.), *Megarhinus septentrionalis* D. and K., *Orthopodomyia signifera* (Coq.), and *Wyeomyia smithii* (Coq.).

Two rare species have been recorded for this state by other writers. King *et al.* (1943) list *Aedes trivittatus* (Coq.) from Camp Butner and Dyar (1922) reports *Culex pilosus* (D. and K.) from Charlotte.

At the present a total of 44 species and 4 subspecies of mosquitoes have been taken in North Carolina.

ADDENDUM

A recent article by Middlekauff and Carpenter in the Journal of Economic Entomology, Vol. **36,** No. 1, February 1944, adds two new species to the previous list, *Aedes cinereus* Meig, Camp Sutton, July 21, 1943, and *Uranotaenia lowii* (Theob.), Camp Mackall, June 25, 1943. Recently *Aedes cinereus* Meig has also been taken at Swannanoa, (L) 15, March 30, 1944, M. J. Kirsch and HFS. These larvae were found in a small, temporary, grassy, open roadside pool, together with those of *Aedes canadensis* (Theob.), the latter species greatly predominating. Lts. M. J. Kirsch and A. J. Barth of the Moore General Hospital had made several earlier collections of *Aedes cinereus* Meig from the same breeding area.

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THE YEAST NADSONIA IN AMERICA

By John N. Couch

Plate 1

The yeast *Nadsonia fulvescens* was isolated from the exuding sap of an oak near Leningrad, U.S.S.R., and was described by Nadson and Konokotine (1911) as a new genus under the name *Guilliermondia*. Shortly thereafter Sydow (1912) called attention to the fact that this name had already been used by Boudier for another fungus and proposed the name *Nadsonia* for the genus in question. In 1913 Konokotine described a second species of the same genus isolated from the sap of a birch tree near Smolensk, and in 1925 Kostka described a third species from the "milchfluss" of *Carpinus Betulus* L. near Brünn, Czecho-Slovakia.

This genus is of considerable interest because of the single-spored ascus, the unusual way in which the conjugating cells are formed and the heterogamic conjugation. Apparently none of the species have been reported again since they were first described.

Early this spring (March 28, 1943) I found *Nadsonia fulvescens* growing abundantly on the sap from stumps of recently-cut birch trees near Chapel Hill, N. C. On several stumps the entire cut surface and the side where the sap was running down were covered with the growth of this yeast and other organisms. Usually the growth was white and foamy, like finely beaten egg white. On some stumps the white was mixed with a pinkish growth, in others the margin was pale yellowish. The growth gave off a slight, pleasant odor of fermentation and attracted numerous fruit flies and other small insects.

A microscopic examination showed that the growth consisted of *Nadsonia* sp., *Endomyces* sp.?, a small nearly spherical yeast perhaps *Debaryomyces*, *Schizosaccharomyces* sp., *Mucor* sp. (homothallic), *Graphium* sp., and *Streptococcus*. The *Nadsonia*, *Endomyces* and *Mucor* sp. were isolated in pure culture.

A study of the accompanying table summarizing the characteristics of all three species of *Nadsonia* seems to indicate that the differences between the species is very slight. The only apparently significant morphological differences are in the shape of the male gamete which in *N. elongata* are elongate instead of oval; and in the smaller size of the ascospore in *N. elongata*. However, in *N. Richteri* the male gamete is oval to elongated as is also the case in the species from Chapel Hill. The Chapel Hill species, found in the slime of *Betula*, agrees best morphologically with *N. fulvescens* found in the slime of *Quercus*, but in its fermentation ability agrees best with *N. elongata*, found also in the slime of *Betula*. In 1927 Nadson sent the Centralbureau für Schimmelkulture a second culture of *N. fulvescens* which was studied by Stelling-Dekker (1931) and identified as *N. elongata*. Stelling-Dekker (1931) studied cultures of all three species of *Nadsonia* and accepts all three as valid. Kostka (1925) in describing his new species says that it agrees neither with *N. fulvescens* nor with *N. elongata*, but occupies a mid-position between the two and therefore must be recognized as a new species. The

present species agrees in certain respects with each of the other three, but fails to agree in all respects with any one. It seems to agree best with *N. fulvescens*, but differs from that in its fermentation ability, its slightly larger ascospores and in the occasional arrangement of the asci in a saddlebag-like series. It is probable

TABULATED COMPARISON OF THE SPECIES OF NADSONIA
(Modified after Kostka, 1925)

	N. fulvescens	*N. elongata*	*N. Richteri*	*N. fulvescens* from North Carolina
Shape of veg. cells	Elliptic, oval, lemon or spindle-shaped	Oval cells more elongated than in *N. fulvescens*	Long-elliptic, apiculate at both ends, pear- or spindle-shaped	Oval to cylindrical
Size of veg. cells	4–7.4 x 15μ	6–8 x 17	4–7 x 10–15	4–8 x 12–18
Cell contents	Glycogen, fat		Glycogen, fat & volutin	as *N. Richteri*
Male gamete	Oval	Elongate	Oval or elongated	Usually oval but very variable
Ascus	Spherical or pear-shaped	Oval or elliptic	Long-oval to pear-shaped	Spherical to oval
Ascospore	Spherical, yellowish, wall spiny or warted 4–6μ thick	3.8–4.8μ thick	Round, seldom oval, membrane spiny or warty; 3.8–4.5μ	Spherical, yellowish, spiny, 4.2–8.4, usually not over 6.3μ thick
Appearance of colony on agar	Smooth with crenate margin	Wrinkled rosettes	Tuberculate, margin slightly crenate	Surface smooth, margin slightly crenate
Ferments	Dextrose, levulose, mannose, galactose, saccharose, maltose (Stelling-Dekker says no ferm. saccharose)	Dextrose, levulose, mannose	Dextrose, maltose	Dextrose, levulose
Occurrence	Oak—*Quercus*	Birch—*Betula*	Hornbeam—Carpinus	Birch—*Betula nigra*

that all of the collections of *Nadsonia* previously described including the present form should be treated as physiologic races under the one name of *N. fulvescens*. However, in the yeasts as in the bacteria, physiological behavior is given more importance in the establishment of species than in other groups of fungi.

NADSONIA FULVESCENS (NADSON AND KONOKOTINE) SYDOW

Cells oval, ovoid, elongated or elongated lemon-shaped, sometimes elongated and flattened on one side, or bent-elliptic, not rarely apiculate at one or both ends; occurring singly or in couplets or in small clusters or chains of bud cells in liquid media, with a few short, branched or unbranched, constricted filaments; bud cells arising from a broad base. Vegetative cells 5–8 x 12–18μ, protoplasmic contents with numerous small granules and one or two vacuoles. Ascus formation usually preceded by heterogamic, homothallic copulation of a small male cell with the contents of a larger cell, the contents of both cells passing into a third cell which becomes the ascus. Ascus elongated to globose, 5–10.5 x 10–16μ when elongated, 7–10.5μ when globose; with one spherical, yellowish, minutely spiny spore; spore with one oil drop, 4.2–6.3μ thick, rarely up to 8.4μ thick. Sometimes apparently two spores may be formed but are always covered by a common outer membrane. Ascus, female cell, and male cell typically forming a row of three cells which have a club-like appearance with the male cell the handle. Ferments dextrose, levulose but not saccharose, maltose and lactose. Sometimes two asci may be formed in the same row of four cells, the two female cells in between the two asci, the male cells lacking. These four cells may be either in a straight row or bent irregularly or frequently bent in the middle forming a saddlebag-like structure. As a rule when two asci are formed in such a series only one of the spores matures normally.

Nadson and Konokotine (1911), Konokotine (1913) and Kostka (1925) reported the occurrence of asporogenous races when cultures were growing on solid media. In such cultures, V-shaped sectors would form which were white instead of brownish, due to the absence of the brownish asci. Such asporogenous races could be carried on indefinitely. The Chapel Hill form also gave rise to such races, recognizable by a V-shaped and sharply differentiated, whitish sector. A microscopic examination of the whitish growth showed that asci were exceedingly rare, but not entirely absent. Not rarely such white races in the Chapel Hill form will give rise to brown ascosporic sectors. Such reversion to type was observed on a potato dextrose agar plate streaked over most of the surface with white strain #2 on April 26, 1943. On May 23 a number of V-shaped brown sectors had appeared, nearly all of which were on the outer margin of the streaks.

The process of conjugation and ascus formation has been adequately described by Nadson and Konokotine (1911), Konokotine (1913), and from a cytological standpoint by Nadson and Konokotine (1926). My observations made only on living material confirm theirs and hence a summary will suffice.

Asci were produced abundantly in the original scum. On Blakeslee's #230 agar, bud cells were large and growth very vigorous, but asci were produced sparingly even after 48 hours. After nine days asci were formed in about 50% of the cells. On Sabauraud's agar, growth was fair, but no asci were formed. On corn meal agar, agar #5 (2% agar, 0.3% maltose, 0.1% meat peptone), and potato dextrose agar, over 90% of the vegetative cells formed asci.

In ascus formation a vegetative cell sprouts a bud at one end which grows to

about one fourth the size of the parent cell. The two now become separated by a wall which is soon dissolved and the protoplasm of the bud cell flows back into the parent cell. Meanwhile at the opposite end of the parent cell another bud appears. This increases in size and receives the protoplasm and two nuclei from the smaller and larger cells. The nuclei now fuse, this fusion being followed by two nuclear divisions so that the young ascus contains four nuclei, three of which ordinarily degenerate (Nadson and Konokotine, 1926). According to these authors two, three or even four nuclei may sometimes persist, with the formation of an ascospore for each nucleus. In the Chapel Hill form I have never observed more than two spores and these are incompletely separated (Fig. 22).

As a rule the female cell is in the middle, the male cell at one end and the ascus at the other end, the three cells being arranged in this very characteristic linear series forming a sort of club-like structure with the ascus the head of the club (Fig. 17, e.g.). Sometimes, however, the smaller or male cell may originate from the side of the larger (Fig. 11) or the smaller may be in the middle of the series (Figs. 13, left, and 14) or two asci may start to form from the end of the same larger gamete, one of the asci aborting (Fig. 10). Rarely the ascus cell may bud out from the tube connecting the large and small cell (Fig. 12), reminding one of the zygote budding from the conjugation tube in some of the species of *Empusa*. In Mayer's solution (Guilliermond, p. 217, 1912) the male cells are very much reduced in size (Fig. 13). On potato dextrose agar or agar № 5, a peculiar condition has frequently been observed in which the linear series consists of two empty middle cells with an ascus on each end of the series. As a rule one of the asci contains an aborted spore (Fig. 15) but sometimes both asci may contain a normal spore (Figs. 19, 20). In such cases where the male cell is lacking it would be interesting to know the nuclear story. In both figures 19 and 20 one of the empty cells is smaller than the other and it may be assumed that the smaller arose by budding from the larger but instead of remaining small and functioning as a microgamete it continued to enlarge, its nucleus divided, and a bud cell was formed which gave rise to a normal ascus. If we are to regard the smaller as the microgamete and the larger as the macrogamete, then we can hardly consider sex as fixed genotypically here, for the small gamete nucleus is potentially the same as the large gamete nucleus since either is capable of giving rise to an ascus. If such is the condition, then it is incorrect to call the small cell the microgamete and the large a macrogamete since both are genotypically alike. There is, however, another possibility. After the nuclei have divided in the large and small cells there may be an exchange of nuclei so that a nucleus from the small cell pairs with a large cell nucleus in the large cell and a nucleus from the large cell pairs with a small cell nucleus in the small cell.

SUMMARY

A yeast isolated from the slime of a birch stump near Chapel Hill, North Carolina, has been identified as *Nadsonia fulvescens*. Apparently this is the first time this genus has been reported outside of Europe. The present species does not agree precisely with any one of the three previously described, but seems closest

to *N. fulvescens*. Heterogamic conjugation, ascus formation, and the occurrence of asporogenous races are described.

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EXPLANATION OF PLATE 1

Figures 1, 2, 3, 5 × 730, the rest × 1250.

Figs. 1–3. Pseudomycelium in Mayer's solution.

Fig. 4. Showing shapes of cells in original slime. Cell contents diagrammatic.

Fig. 5. Asci formed in pseudomycelium.

Figs. 6–9. Stages in formation of male gamete, conjugation and ascus formation.

Fig. 10. Two asci from one conjugation, the lower with an abortive spore.

Fig. 11. Male cell attached to side of female, a rare arrangement.

Fig. 12. Ascus budding from conjugation tube suggestive of *Empusa sepulchralis*.

Fig. 13. Conjugation in Mayer's solution. Note very small male cells, with ascus arising from smaller cell to left.

Fig. 14. Mature ascus with small cell in middle and large gamete on end.

Fig. 15. Abortive ascus arising from small gamete, normal one from female.

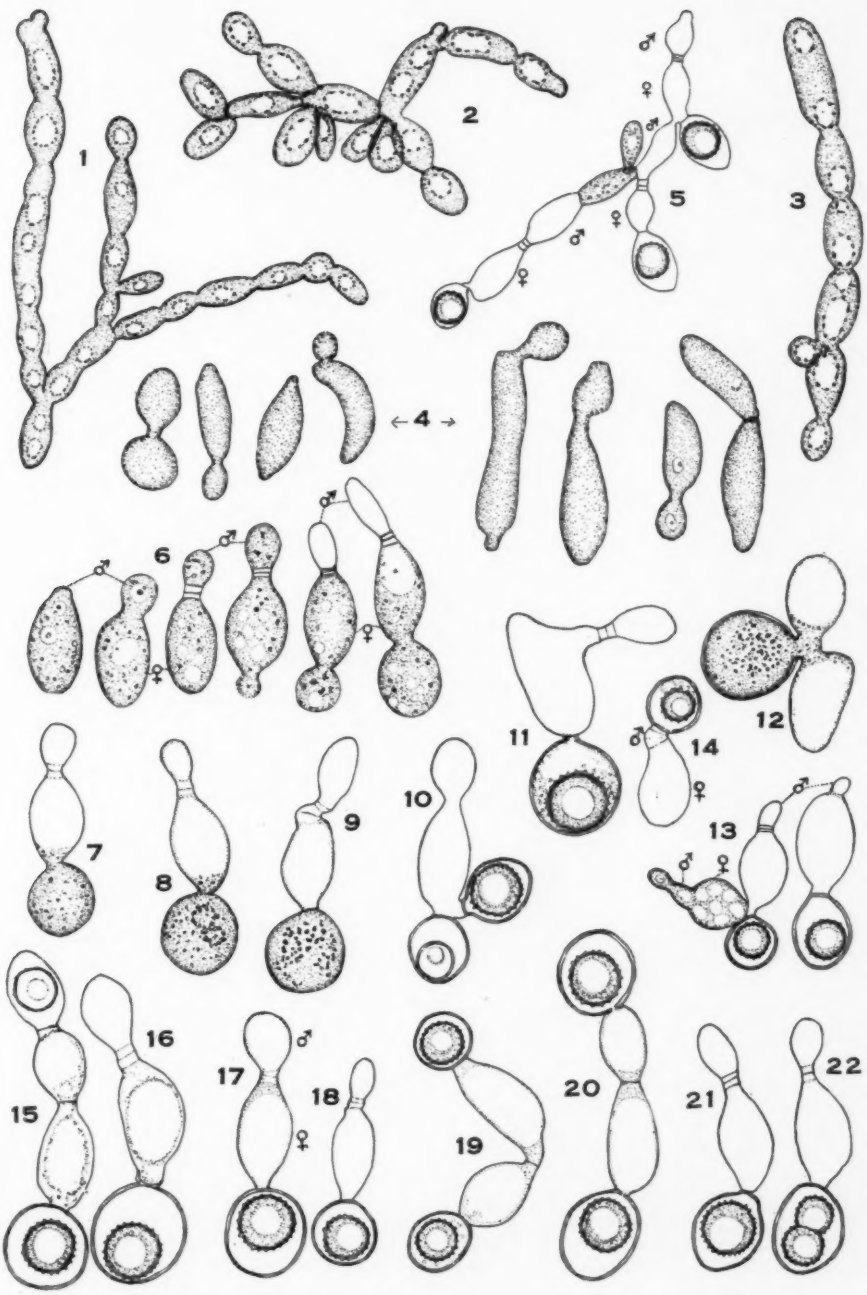
Figs. 16, 17, 18. Typical appearance of male, female and ascus cells.

Figs. 19, 20. Normal asci apparently formed without conjugation between small and large gametes.

Fig. 21. Normal ascus almost separated from female cell.

Fig. 22. Ascus with two spores, incompletely separated.

PLATE 1



NEW OR RARE HETEROBASIDIOMYCETES FROM NORTH CAROLINA—I

By Lindsay S. Olive

Plates 2-8

During the months of December, 1943, and January, 1944, a considerable number of collections of saprophytic Heterobasidiomycetes were made by the author in and around Chapel Hill, North Carolina, during a search for interesting forms which appear during the winter months. The result was the discovery of several new species, as well as other interesting fungi heretofore found rarely or not at all in this area. Especially noteworthy is the discovery of *Tulasnella* and *Gloeotulasnella*, which seem never before to have been reported from the Southeastern States.

Platygloea unispora sp. nov.

Plate 2, fig. 3, and Pl. 4, figs. 1-11

Pustulate, the pustules more or less circular, minute, mostly 0.4-0.5 mm. in diameter, but some as small as 0.25 mm., gregarious or sometimes scattered, usually not anastomosing, waxy, brownish yellow or yellow when moist, contracting somewhat on drying and becoming cinnamon brown to dark brown. True paraphyses not present, but basidia occasionally germinating abnormally to produce irregular, branched structures; clamp connections abundant on subhymenial hyphae and at the bases of the basidia; basidia non-septate or with 1-3 transverse septa, cylindrical, 6.1-7.6 x 61-83μ; basidiospores subspherical to broadly oval, 10-13.7 x 13.7-18.3μ, only one spore formed on each basidium.

Underside of cedar branches lying on the ground, Battle Park, December 11, 1943.

The basidia in this species seem to be unique in producing only one spore each. None of the basidia observed were found to have more than one sterigma. The sterigma is formed by the tapering upwards of the apex of the basidium. Rarely, a septate basidium was found with more than one of its cells germinating, but in such cases the basidium apparently develops into a sterile, branched, paraphysis-like structure. A considerable number of basidia show no transverse septa at all, while others are 1-3-septate. During germination of the latter, the septa often collapse to allow more protoplasm to pass up into the single basidiospore. Basidia do not collapse for some time after germination, and few of the empty basidia show transverse septa.

This fungus is particularly interesting from a phylogenetic standpoint. In the 17 species of *Platygloea* found in the literature, the basidia were quite variable, ranging from 1-5-septate, the number of septa often varying in the same species. Evidently, *P. unispora*, like several other species in the genus, is still in a considerable state of flux and appears to be evolving from the 4-celled *Auricularia*-type of basidium to a 1-celled and 1-spored basidium. The abundance of

1-celled basidia as well as the presence of 2–4-celled basidia in the hymenium, the ephemeral nature of the cross-walls in the septate basidia, and the production of only one spore on each basidium are indicative of this.

Tremella grandibasidia sp. nov.

Plate 3, fig. 2, and Pl. 4, figs. 12–21

Firmly gelatinous, pulvinate, spreading, with thick irregular folds, nodulated, light straw yellow to dingy yellow when moist, largest fructification about 1½ x 2–3 cm. and 6 mm. high, some smaller and not more than 1½ mm. in height, drying to a thin, horny, brown, resin-like layer which is very inconspicuous. Basidia large, oval, 4-celled, or sometimes 2-celled, often with eccentric septa, 21.4–30.5 x 30.5–42.7μ; sterigmata rather long; spores nearly or quite globose, 15.3–16.8μ in diameter. Clamp connections abundant on the hyphae.

On bark of a fallen branch of a deciduous tree, possibly Mimosa, Battle Park, December 11, 1943.

This specimen is distinguished from all other species of *Tremella* described in our area by its very large basidia and spores. The only other yellow species reported growing on deciduous wood in this locality is *T. lutescens* Pers., which is light orange in color and bas much smaller basidia and spores. (See Coker, Jour. Elisha Mitchell Sci. Soc. **35:** 138. 1920.) A search through the literature failed to reveal any description which would include the present species. The fungus is named for its large basidia, which average about 25.5 x 36μ.

Exidia Cokeri sp. nov.

Pustulate, pustules small, 250–1000μ in diameter, gregarious and becoming confluent into patches several millimeters in length, fungus covering areas on bark varying from 5 x 5 to 7 x 25 cm. and 0.1–1.5 mm. in thickness. Larger patches nodulated or undulate and convoluted, nearly cerebriform in appearance. Tender gelatinous, smoky gray to rusty brown, drying to a very thin and inconspicuous vernicose membrane, deep brown to blackish brown in color, or to small amber-colored resin-like masses in the case of the small pustules. Sterile fructifications rusty brown, fertile ones light brown or gray.

Clamp connections present, but not abundant. Paraphyses 1.9–3.4μ in diameter, much branched and septate, particularly abundant in sterile fructifications and very brown in color, due to their being incrusted with brown deposits, lighter in color in sterile fructifications as a result of less mineral deposits or the entire absence of such deposits on the younger paraphyses. Paraphyses gelatinizing completely in some fructifications, but generally leaving brownish granules in the hymenium. Basidia globose, oval, or oblong, 4-celled, with the septa frequently oblique in arrangement; 8.7–12.2 x 9.2–15.3μ. Spores varying greatly from entirely straight to conspicuously reniform, apiculate, 3.8–5.8–7.0 x 8.7–12.2–15.3μ, germinating in various ways, i.e., by forming a germ tube, by the production of conidia, or germinating by repetition.

Three collections were made on the same date from a wooded area on the back

part of Professor W. C. Coker's place. The three specimens, when first brought in were considered to be three different species. However, after an extended examination of these collections, we believe that they represent a single species, heretofore undescribed. In order to aid the collector in recognizing any of these forms in the field, the writer submits the following brief description of each type collected.

Form A

Plate 2, fig. 1, and Pl. 5-A

Composed chiefly of small pustules, 250-900μ in diameter, dull brown in color, gregarious to effuse, 500-600μ thick, covering an area on bark 6-7 x 25 cm., sometimes confluent into irregular, nodulated patches, a few rusty brown sterile patches scattered about among the fertile fructifications, pustules drying to small amber-colored resin-like masses.

Paraphyses present, smooth and hyaline at first, irregular, much-branched and septate, frequently showing hyphal fusions, becoming incrusted with rusty brown deposits, extending 15-50μ above basidial layer, 1.9-3μ in diameter. Basidia subglobose to pyriform, often with eccentric cross walls, sterigmata generally quite long, 20-100μ in length, much longer (up to 500μ) if germinated on a slide in water, basidia measuring 9.2-12.2 x 12.2-15.3μ. Spores usually quite straight or only slightly curved, apiculate, 4-6-7.0 x (9.2-) 12.2-15.3 (-18)μ, becoming 1-4-septate or remaining 1-celled, germinating to form small rod-shaped conidia or by the production of germ tubes. No germination by repetition observed.

Growing on bark of fallen limb, probably beech, December 27, 1943.

Form B

Plate 2, fig. 2, and Pl. 5-B

Composed mainly of small, light dusky brown to smoky gray pustules, 250-915μ in diameter, gregarious and effuse, freely anastomosing; patches extending 5 cm. or more along bark of dead limb, 100-600μ in thickness, drying to a very thin and inconspicuous vernicose membrane.

Paraphyses almost completely gelatinized, persistent fragments showing brownish incrustations, also brownish granules abundant in hymenium after disappearance of paraphyses. Basidia globose to oblong, 9.7-11.7 x 11.2-14.6μ, sterigmata usually not as elongated as in the previous form, 15-45μ in length; spores mostly conspicuously reniform, some nearly straight, 3.8-5.8 x 10.7-13.7μ, germinating as though to produce secondary spores, but producing only germ tubes during observation in the laboratory.

On bark of fallen branch of a deciduous tree, Dec. 27, 1943.

Form C

Plate 5-C

Pustulate, but becoming confluent into irregular, lobed and undulate patches, individual pustules mostly 500-750μ in diameter. Effuse and forming exten-

sive, rather conspicuous, rusty brown patches, covering an area 3 x 8 cm., up to 1.5 mm. high, drying into a thin and inconspicuous, horny, deep brown to blackish brown film.

This collection, when first brought into the laboratory was completely sterile, with large much-branched and septate paraphyses, incrusted with brownish granules. After a few weeks in a cool moist chamber, however, the fungus began to produce basidia and spores. The spores were about intermediate in form between those of Forms A and B. The smaller pustules of the fungus are indistinguishable from those of the other two forms.

Basidia 8.7-9.7 x 9.2-11.7μ, with long sterigmata as in form A, globose to oval or pyriform; spores slightly curved to allantoid, 4.8-5.8 x 8.7-12.6μ, germinating by repetition.

On bark of fallen oak branch, December 27, 1943.

It is obvious that here we are dealing with a very variable species. The method of spore germination probably varies with growth conditions, as well as with the stage of development of the fungus. In Form A, for example, a number of old septate basidiospores were found in some of the pustules and a small proportion of the new spores became septate when the fungus was first brought in. Later, however, the spores ceased to become septate and began to produce long germ tubes. Other characters, such as the presence or absence of paraphyses, are also variable. These three forms, therefore, should not be considered of varietal significance, since the characteristics which would at first appear to distinguish them from each other are subject to variation and intergradation.

Sebacina epigaea (Berk. & Br.) Bourd. & Galz. var. **bicolor** n. var.

Plate 3, fig. 4, and Pl. 6, figs. 1-11

Hymenium firmly waxy-gelatinous, light ochraceous-buff to ochraceouss (Ridgw.), warty and usually distinct from the light yellow spongy-fibrous subiculum. When dry the hymenium shrinks to thin, horny, rusty patches against a light yellow (Naples yellow—Ridgw.) corticioid subiculum. Growth indeterminate, several centimeters in width and at least 15 centimeters long in our collection, 160-1100μ overall thickness, hymenium (referring to the entire area bearing basidia and paraphyses), 200-600μ thick.

Paraphyses simple to several times branched, smooth, without granules, 2.2-4.6μ in diameter; subicular hyphae 2.7-6.9μ in diameter; basidium-bearing hyphae 3-4.6μ broad. No clamp connections observed. Basidia 16.8-19 x 21.4-26.9μ, probasidia sometimes becoming transformed into irregular resting cells; sterigmata long, sometimes reaching a length of 120μ; spores 9.1-11.4 x 13.7-20.0μ, germinating by repetition, allantoid, some becoming transformed into irregular resting cells.

Underside of very rotten oak log, in woods back of Kenan Stadium, December 21, 1943.

This fungus is apparently a variety of *S. epigaea* with unusually large basidia,

spores, and hyphae. The specimens of *S. epigaea* (Nos. 4116 and 4758) collected by Coker (see Jour. Elisha Mitchell Sci. Soc. **35**: 157, No. 2. 1920.) have basidia and spores with dimensions which fall within the measurements given by McGuire (Lloydia **4**: 1–43. 1941) in his monograph of the genus: basidia 10–14 x 14–19μ; spores 6–8 (–10) x 8–13.5μ. Two specimens of *S. epigaea* collected in Chapel Hill this winter by the author also have basidia and spores with similar dimensions.

We were at first inclined to describe the fungus as a new species, but on observing basic similarities between this fungus and typical *S. epigaea* in color and texture of the fructifications and the presence in each of irregular resting cells derived from spores and probasidia, we concluded that our new specimen is only of varietal significance. The varietal name describes the appearance of the fungus when dry. The hymenium dries to conspicuous rust-colored spots over a light yellow subiculum.

Sebacina sordida sp. nov.

Plate 3, fig. 3, and Pl. 7, figs. 1–10

Resupinate, effuse, our collection measuring 3.5 x 10 cm. on decorticated wood, waxy-gelatinous to mucous-gelatinous, nodulated, gyrated in places, thin, mostly 200–325 μ in thickness, but in some parts up to 800 μ thick, margin thinning out, indeterminate; color smoky tan or light brownish olive, drying to a very thin nodulated light brown to amber-colored vernicose membrane, which is horny in texture and almost invisible without a hand lens. No calcareous granules were observed; no cystidia present.

Paraphyses scarce in the material examined, apparently fugaceous, narrow and rather irregular, generally branched, 1–1.8 μ thick. Clamp connections abundant. Basidia mostly globose, or nearly so, some ranging to pear-shaped, 9.0–9.5 x 9.2–12.2 μ, sterigmata up to 35 μ in length; spores reniform, 4.1–4.6 x 10.4–11.6 μ. The basidia are produced mostly in a series along the hyphae, probably through proliferation from clamp connections at the bases of preceding basidia. Clamps seem to be formed early at the bases of the probasidia.

Growing on decorticated pine limb on the ground in woods on the back part of Professor W. C. Coker's place, December 27, 1943; also on dead sycamore limb, Battle Park, March 13, 1944.

This fungus approaches *S. podlachica* in size of basidia and spores, but has slightly larger basidia than that species and the spores are more elongate. A comparison was made with a specimen of *S. podlachica* sent to us by Professor G. W. Martin. Martin's specimen varied from our new species in having a more compact hymenium with abundant paraphyses, smaller basidia, no long series of proliferating basidia, and less slender spores. The texture and color were about the same when moist, but on drying Martin's specimen formed a conspicuous, turbid or opaque, yellowish-brown crust.

Sebacina fugacissima, according to McGuire's description (Lloydia 4: 1–43. 1941), has basidia borne in proliferating series, and is evanescent on drying.

Basidia and spores, however, are much smaller. *S. opalea*, which also belongs to this group of thin gelatinous Sebacinas, has a very different type of spore, one which is stouter and obovate in shape.

Sebacina molybdea McGuire

Plate 6, figs. 12-16

Waxy-gelatinous, effuse; forming extensive patches, 10–15 cm. in length, along rotten oak wood and bark, color a rather dull bluish gray when moist, drying to a white crust, looking much like a *Corticium*.

Paraphyses not very distinct, apparently gelatinizing very readily. Clamp connections present. Basidia subglobose to obovate, 11.4–13.7 x 13.7–16.8 μ; spores subglobose to broadly ovate, 7.2–9.2 x 10.7–13.7 μ, germinating by repetition.

Growing on rotten wood and bark of an old oak limb on the ground, Battle Park, January 28 and February 29, 1944.

This fungus was described as a new species by McGuire (*loc. cit.*) and was reported by him only from Iowa in autumn and in early spring, mostly in April. The present writer collected it two or three times on the same day in Chapel Hill, and observed a particularly good growth of it a month later on one of the same decaying logs from which an earlier collection was made.

Tulasnella bifrons Bourdot & Galzin

Plate 2, fig. 4, and Pl. 7, figs. 18-26

Fructification a thin interrupted layer, somewhat porous in appearance under the hand lens, with tiny bumps, soft-waxy, pruinose, grayish to pinkish when moist, drying to a thin, shell-pink (Ridgw.) layer, almost crustose in some areas, or to an inconspicuous, faintly pinkish, arachnoid or porous layer. Clamp connections scarce.

Basidia somewhat elongate, obovate to pyriform, 5.8–7.8 x 9.7–14.6 μ; epibasidia generally obovate when cut off from the basidium, 4.9–5.8 x 7.3–8.7 μ; somewhat obliquely attenuated at the base, 4–5 x 5.8–7.8 μ, some secondary spores smaller, resulting from germination by repetition. Spore print pink.

Growing on underside of moist rotting elm wood and over the hymenium of decaying bracket fungi, Mason Farm, Jan. 19, 1944.

A specimen of the fungus was submitted to Dr. D. P. Rogers, to whom we are indebted for the identification of this species. Rogers apparently accepts the spore form as the chief diagnostic character here. Our measurements for spores and basidia are inclined to be somewhat larger than those given by Rogers in his taxonomic review (Annales Mycologici **31**: 181-203. 1933).

Tulasnella albida Bourdot & Galzin

Plate 7, figs. 11-17

Thin, pruinose, grayish-white growth when moist, texture rather soft waxy, evanescent on drying and not noticeable to the unaided eye, reviving readily on

being moistened; no gloeocystidia present, clamp connections abundant on the hyphae and at the bases of the basidia.

Probasidia subglobose to obovate, basidia broad, ovate to elongate club-shaped, often with slender stalk, 6.9–9.2 x 10.7–15.3 μ; epibasidia obovate at first, becoming elongate and cylindrical, 5.3–7.5 x 7.6–10.7 μ, a considerable number falling off the basidia when placed on a slide in water and becoming confused with the spores. Spores subglobose to short-elliptic, often flattened on one side, 5.3–7.6 x 7.6 x 7.6–9.3 μ, germinating by repetition (laterally or apically).

Growing on underside of a rotten decorticated oak log, Battle Park, January 28, 1944.

This specimen does not seem to vary significantly from *T. albida*, as defined by Rogers (*loc. cit.*). It appears that the species has been heretofore collected only in France. Rogers has made a collection of *T. araneosa* Bourd. & Galz. from Iowa and states that *T. albida* may not be distinct from that species. However, the measurements and other characteristics of our specimen seem to fit best the description of *T. albida* as given by Rogers.

Gloeotulasnella cystidiocarpa sp. nov.

Plate 3, fig. 1, and Pl. 8

Fungus forming a very thin, mucous, watery-white, inconspicuous layer covering almost an entire side and one end of a chunk of old heartwood, probably deciduous, about 3 feet in length, sometimes becoming slightly purplish-tinted with age. Numerous scattered pustules containing only gloeocystidia, white, soft mucous, 0.25–1.0 mm. in diameter, up to 0.5 mm. high, patches sometimes coalescing, yellowing after repeated desiccation. Gloeocystidial formation accompanied by conspicuous clamp connections, mature gloeocystidia elongate, often club-shaped and tapering at the base with hyaline contents, breaking off from parent hyphae very easily, sometimes becoming septate, frequently germinating and producing hyphae with clamp connections, germination particularly abundant on agar, gloeocystidia measuring 9.2–12.2 x 21.4–33.6 μ. Clamp connections abundant on all hyphae. The entire fungus dries to a very inconspicuous film, reviving readily when moistened.

Basidia formed with clamp connections, elongate, club-shaped, probasidia very similar in appearance to young gloeocystidia, 9.2–15.3 x 22.9–29.0 μ; epibasidia mostly pyriform or obovate, 8.4–11.0 x 10.7–18.3 μ, producing fairly long, tapering sterigmata; spores mostly subglobose, but frequently oblong and flattened on one side, 9.1–10.0 x 12.2–14.5 μ, germinating freely by repetition and thereby becoming progressively smaller (6.1 x 7.6 μ), spores sometimes producing small round conidia. Spore print white.

Growing on old soggy piece of heartwood, probably of a deciduous tree, Mason Farm, January 12, 1944.

After a study of the literature on European and American species of *Tulasnellaceae*, with particular reference to the taxonomic review of the group by Rogers (*loc. cit.*), the writer has been unable to find any description of a species

with gloeocystidia present and in separate pustules. The fungus is also unique in having very large basidia and spores.

Trechispora Brinkmanni (Bres.) Rogers & Jackson
Corticium coronilla v. Höhn & Litsch.
Sistotrema coronilla (v. Höhn & Litsch.) Rogers

Plate 7, figs. 27-33

Very thin, sparse, pruinose, white, effuse, patch measuring 1-1.5 x 6 cm. long, macroscopically like a thin *Tulasnella*, evanescent on drying; hyphae with abundant clamp connections; probasidia appearing in clusters, 4.9-6.8 x 5.8-8.8 μ; basidia urniform, 11.7-15.6 μ long, usually with 6-8 sterigmata; spores 1.9-2.9 x 4.9-6.0 μ, elongate and slightly curved.

Growing on the underside of a very rotten log, probably deciduous, Mason Farm, January 19, 1944.

This species has many synonyms, only two of which are given here. Rogers, in his recent treatment of the genera, *Trechispora* and *Galzinia*, placed the species in the genus, *Trechispora*, which is characterized by the presence of urniform basidia developed from persistent probasidia. (See Mycologia **36:** 70-103. 1944.). The fungus, according to Rogers, was collected earlier in this state by Couch and determined by Burt as *Corticium incanum* Burt. Although the fungus is not a Heterobasidiomycete, it is included here by the writer, since it is an interesting form, and one likely to be confused in the field with various species of *Tulasnella*.

DEPARTMENT OF BOTANY,
UNIVERSITY OF NORTH CAROLINA,
CHAPEL HILL, N. C.

EXPLANATION OF PLATES 2-8

PLATE 2

(All figures × 7.)

Fig. 1. *Exidia Cokeri*, Form A.
Fig. 2. *Exidia Cokeri*, Form B.
Fig. 3. *Platygloea unispora*
Fig. 4. *Tulasnella bifrons*

PLATE 3

Fig. 1. *Tulasnella cystidiocarpa*. × 5
Fig. 2. *Tremella grandibasidia*. × 1¼
Fig. 3. *Sebacina sordida*. × 5.
Fig. 4. *Sebacina epigaea* var. *bicolor*. × 5.

PLATE 4

Platygloea unispora (Figs. 1-11). × 720

Fig. 1. Basidiospores.
Fig. 2. Group of basidia.
Figs. 3 & 4. Development of clamp connections on the basidia.
Fig. 5. Basidium germinating abnormally.
Figs. 6-10. Production of basidiospores. Note the breaking down of cross walls in some basidia.
Fig. 11. Abnormal basidium.

Tremella grandibasidia (Figs. 12–21).

Fig. 12. Probasidium. × 720.
Figs. 13–16. Young septate basidia. × 720.
Fig. 17. Germinating 4-celled basidium. × 720.
Fig. 18. Germinating 2-celled basidium. × 720.
Fig. 19. Basidiospores. × 720.
Fig. 20. Probasidium with parasitic bodies within. × 480.
Fig. 21. Parts of hyphae, showing clamp connections. × 822.

PLATE 5

Exidia Cokeri

Form A: Figs. 1–15.
Fig. 1. Probasidium. × 720.
Figs. 2–4. Development and germination of basidia. × 720.
Fig. 5. Empty basidium. × 1183.
Fig. 6. Basidiospores, one budding out small conidia. × 720.
Fig. 7. Clamp connections. × 1183.
Figs. 8–13. Development of basidiospores, and their various methods of germination. × 1183.
Figs. 14 & 15. Paraphyses. × 1183.
Form B: Figs. 16–21. × 1183.
Figs. 16 & 17. Probasidia.
Fig. 18. Germinating basidium.
Fig. 19. Empty basidium.
Fig. 20. Basidiospores.
Fig. 21. Fragment of a paraphysis.
Form C: Figs. 22–27. × 1183.
Figs. 22–24. Development and germination of basidia.
Fig. 25. Basidiospores.
Fig. 26. Basidiospores germinating by repetition.
Fig. 27. Paraphysis.

PLATE 6

Sebacina epigaea var. *bicolor* (Figs. 1–11).

Fig. 1. Transverse section through fructification, showing substratum (w), subiculum (s), and hymenial layer (h). × 45.
Fig. 2. Section of hymenial layer. × 190.
Fig. 3. Basidium and paraphyses. × 360.
Fig. 4. Probasidia. × 540.
Figs. 5 & 6. Germination of basidia. × 540.
Fig. 7. Basidiospores. × 540.
Fig. 8. Secondary germination of the spores. × 540.
Fig. 9. Irregular resting cells developed from spores. × 540.
Fig. 10. Irregular resting cell developed from probasidium. × 540.
Fig. 11. Probasidia showing abnormal development. × 540.

Sebacina molybdea (Figs. 12–16). × 885.

Fig. 12. Probasidium with clamp.
Fig. 13. Germinating basidium.
Fig. 14. Empty basidium.
Figs. 15 & 16. Basidiospores, some showing germination by repetition.

PLATE 7

Sebacina sordida (Figs. 1–10).

Fig. 1. Hypha showing clamp connection. × 1183.
Fig. 2. Probasidium with clamp. × 1183.
Figs. 3–5. Germinating basidia. × 720.
Figs. 6 and 7. Groups of proliferating basidia. × 720.
Fig. 8. Basidiospores. × 720.
Fig. 9. Germinating basidiospore. × 720.
Fig. 10. Paraphysis. × 1183.

Tulasnella albida (Figs. 11–17). × 1183.

Fig. 11. Probasidium with clamp.
Figs. 12–14. Germinating basidia.
Fig. 15. Empty basidium.
Fig. 16. Basidiospores, some of which are germinating by repetition.
Fig. 17. Basidiospores or detached epibasidia (?).

Tulasnella bifrons (Figs. 18–26). × 1183.

Fig. 18. Probasidium.
Figs. 19–24. Germinating basidia.
Fig. 25. Basidiospores, some of which are germinating by repetition.
Fig. 26. Hypha with clamp connection.

Trechispora Brinkmanni (Figs. 27–35). × 1183.

Fig. 27. Group of probasidia.
Fig. 28. Probasidium and clamp connection.
Figs. 29–32. Germination stages in the production of basidia and spores.
Fig. 33. Basidiospores.
Fig. 34. Hypha with clamp connections.
Fig. 35. Enlarged cells in the hymenium.

PLATE 8

(All figures × 720, except Fig. 1, × $\frac{4}{3}$.)

Gloeotulasnella cystidiocarpa

Fig. 1. Piece of rotting wood showing scattered pustules of gloeocystidia.
Fig. 2. Probasidia.
Figs. 3–9. Germination of the basidia.
Fig. 10. Abnormal germination of basidium.
Fig. 11. Abnormal basidium found near gloeocystidial pustule.
Fig. 12. Basidiospores.
Fig. 13. Basidiospore budding off round conidia.
Fig. 14. Germination by repetition.
Figs. 15–21. Gloeocystidia, some in various stages of germination.

PLATE 2

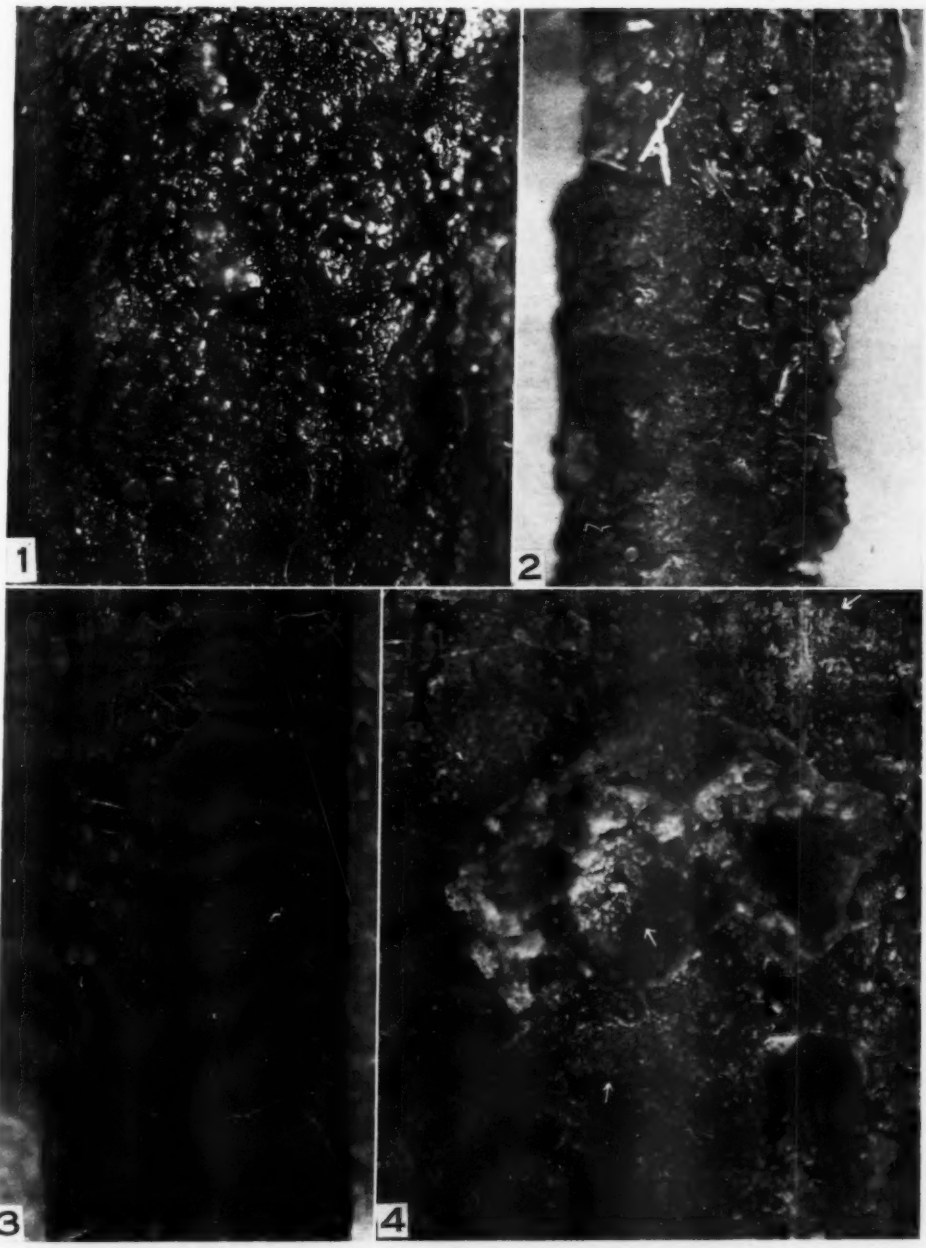


PLATE 3

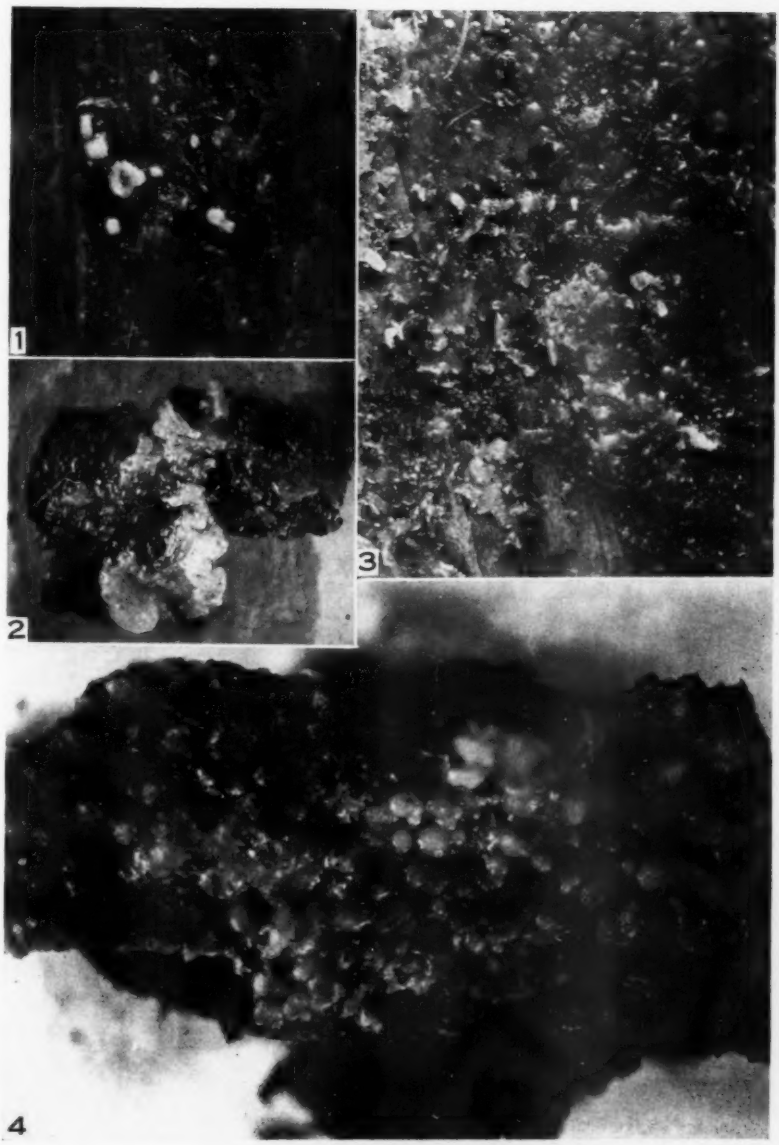
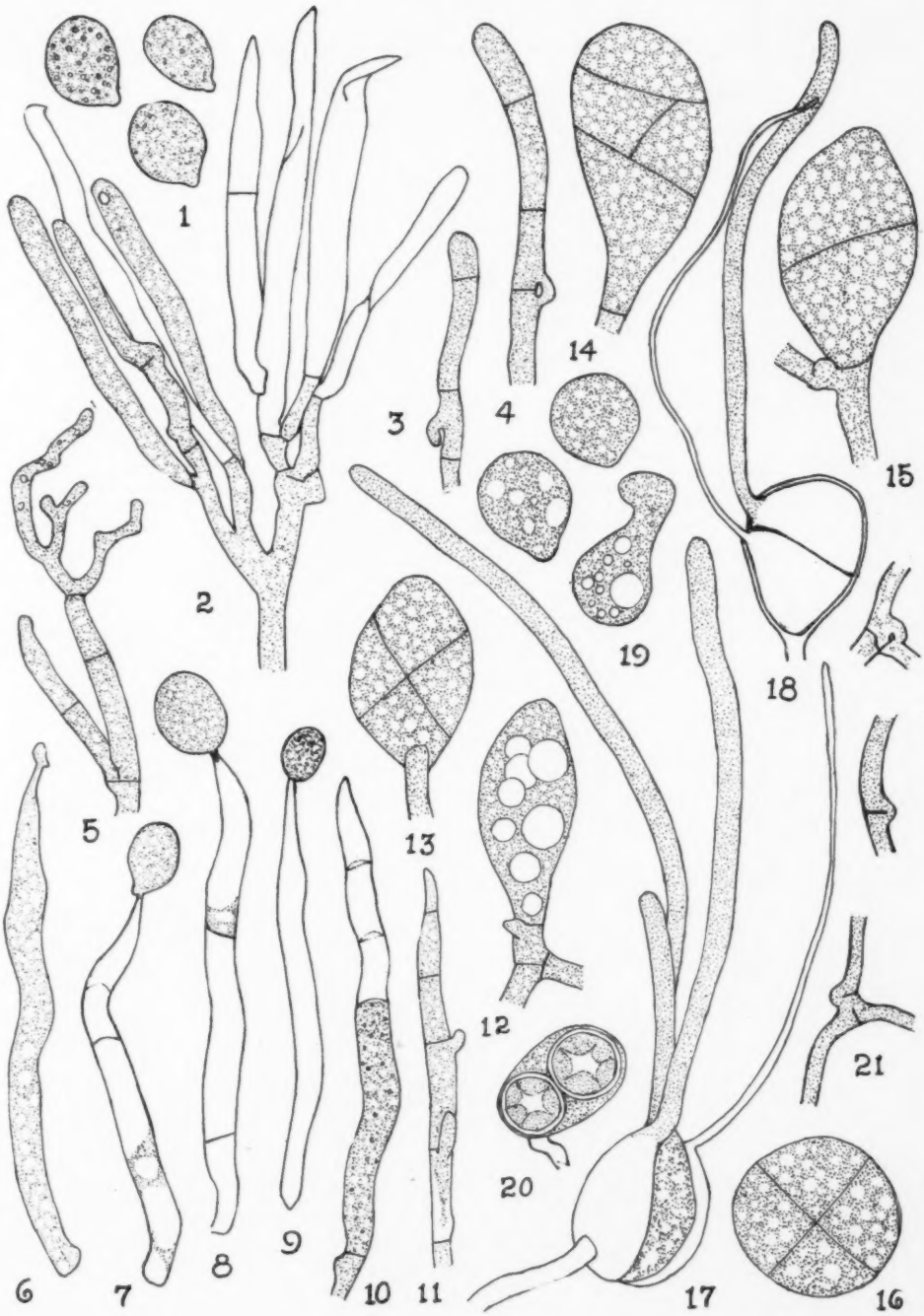


PLATE 4



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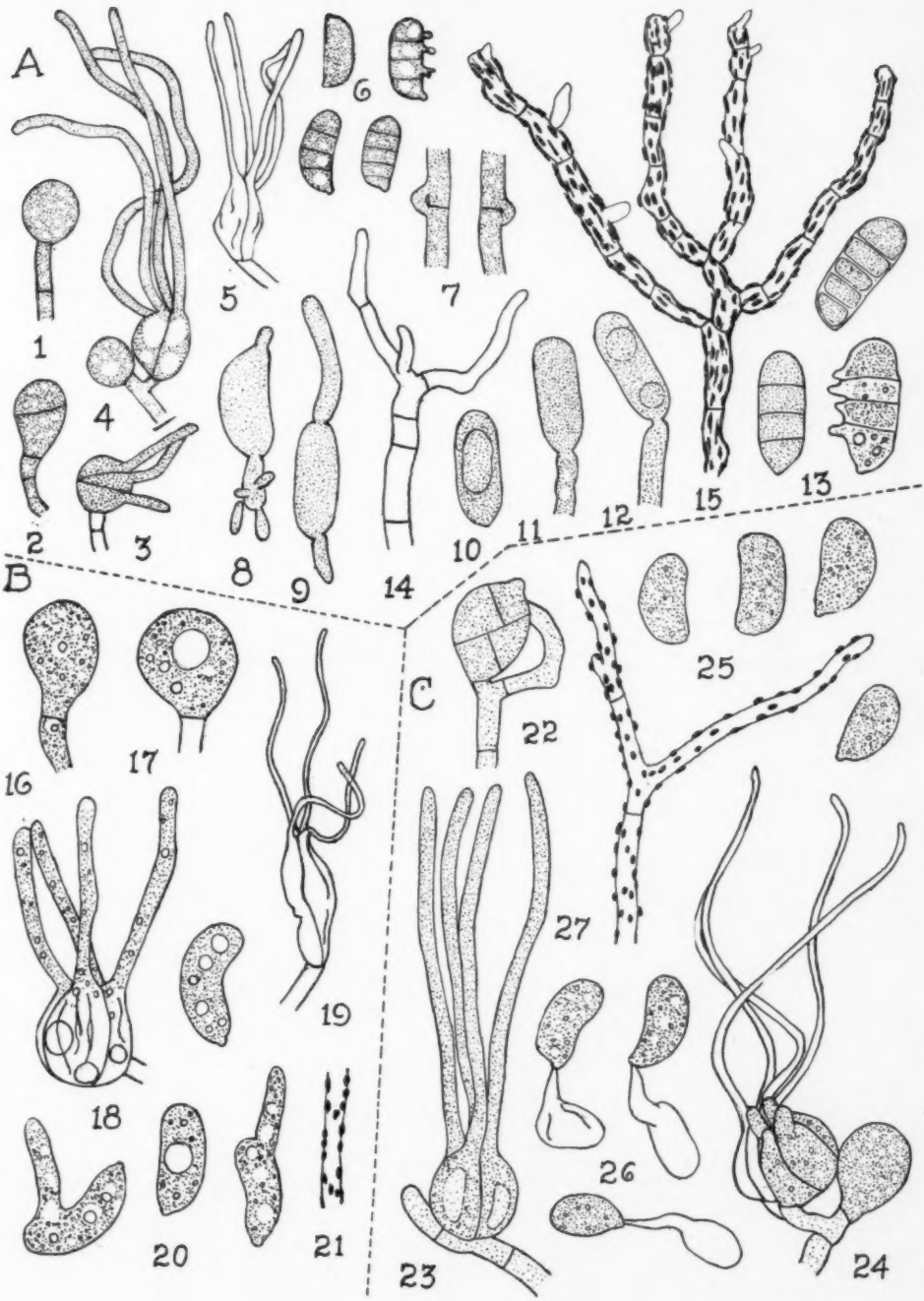

PLATE 6

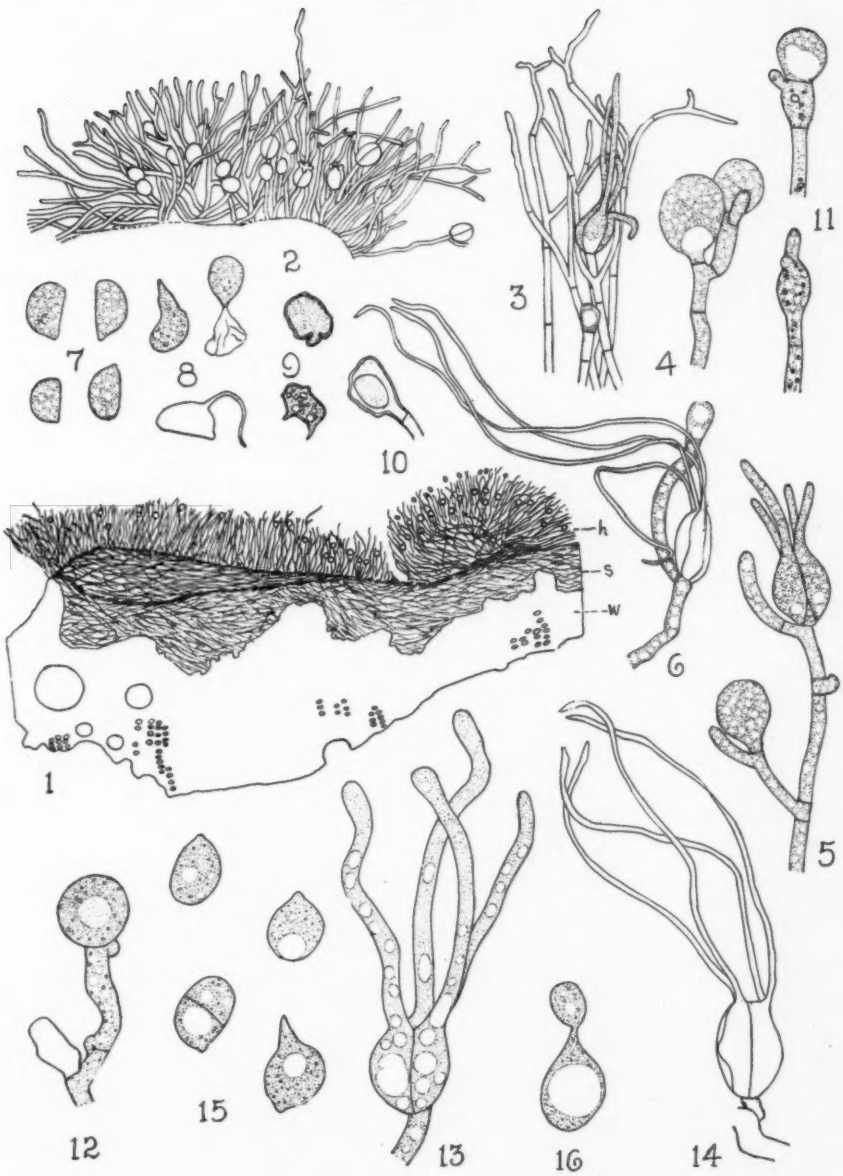

PLATE 7

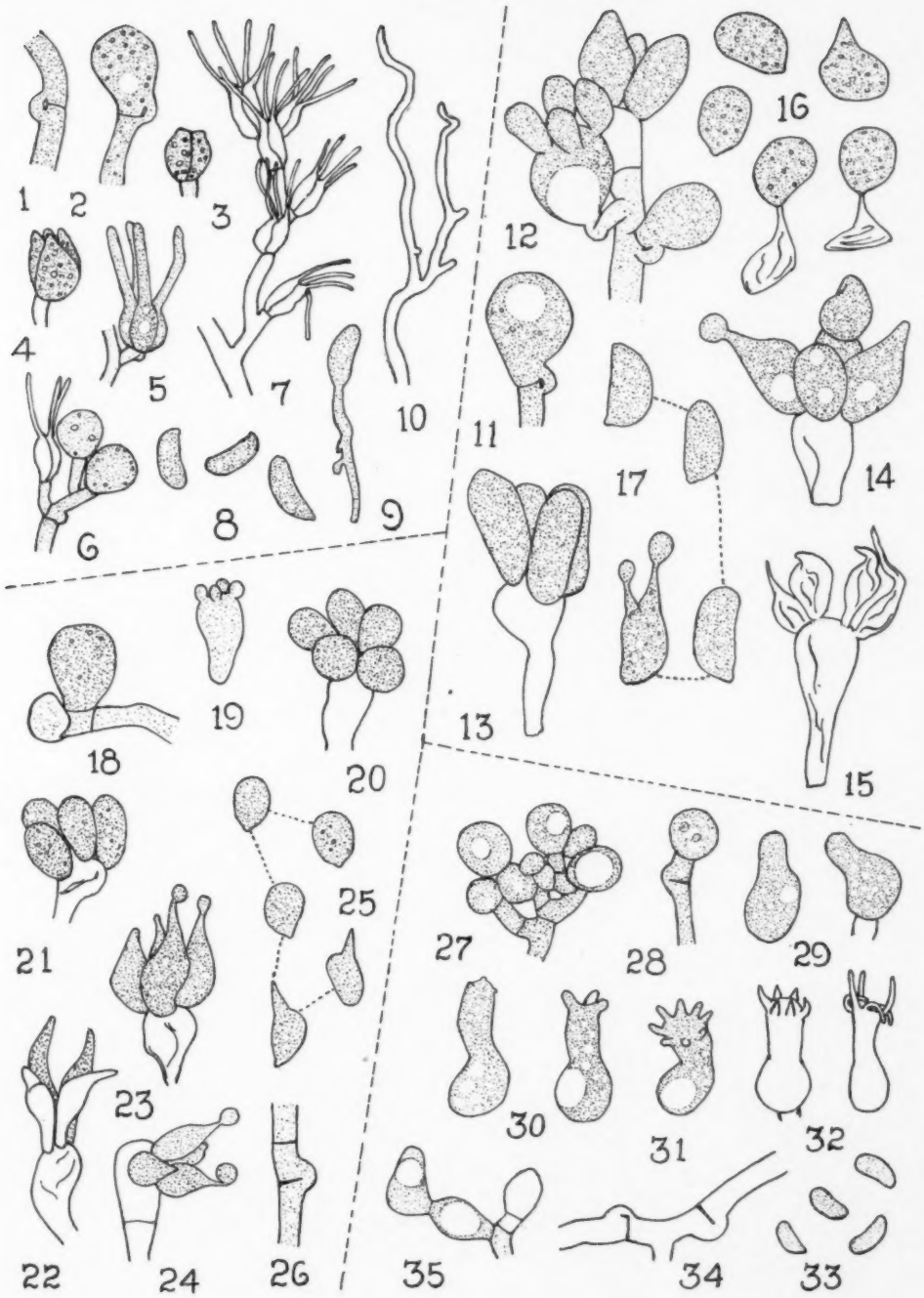
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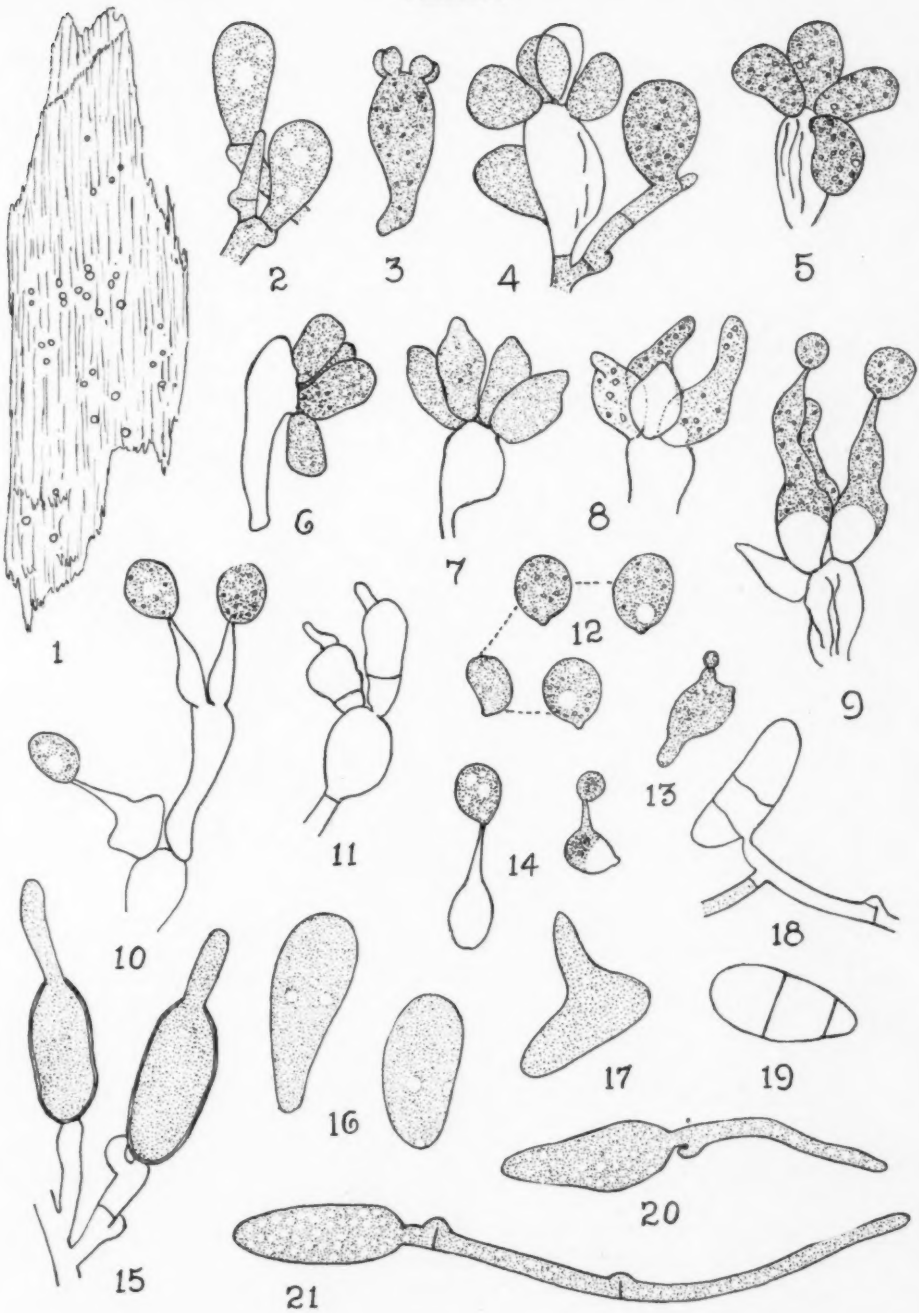
PLATE 8



THE WOODY SMILAXES OF THE UNITED STATES

By W. C. Coker

Plates 9–39

INTRODUCTION

The woody species of *Smilax* of the eastern United States have long been in need of more thorough study. Particularly is this true of the underground parts, which are highly varied and complicated, in most cases furnishing dependable specific characters. Gray's Manual does not mention them at all except in the case of *S. hispida*, where he says "Rootstock cylindrical, elongated." This is noted by De Candolle (1878) who also quotes Chapman's words for *S. Walteri*, "Rhizoma creeping." Except for the word "rhizoma" used in two other cases De Candolle does not refer to the rooting parts in any of our species. Small also omits them under descriptions of the species and under the genus speaks of the rhizomes as "roots." Engler and Prantl ignore the underground parts except to mention the roots as the source of Sarsaparilla. Morong (1894), who has written a useful treatise on the American species of *Smilax*, both woody and herbaceous, has very little to say about parts underground, not mentioning them at all in six of the ten woody species of our eastern states. However, in the case of *S. glauca*, his description of stolons and tubers is the best that has appeared before or since. Holm (1891) figures typical looking, though very small, tubers of *S. glauca* and the rhizome and what he calls tubers of *S. rotundifolia*. The plant shown is entirely too small for the usual fully grown plant of the species, and the so-called tubers are what we would call slightly enlarged joints. We have never found anything that ought to be called tubers in *rotundifolia*. Norton (1917) deserves the credit of being the first to call attention to and illustrate the unique spiny tubers of *S. Bona-nox*, and he mentions the tubers or runners in all the seven native woody species included in his treatment in Bailey's Cyclopedia. Rehder (1940) mentions the rooting parts of most of the species but with little detail. Deams (1932) has published careful and detailed descriptions of the four species native to Indiana. He does not mention the long spiny runners in *S. glauca* or the absence of spines on the runners of *rotundifolia*. Aside from Norton's of *Bona-nox*, the only good illustrations of *Smilax* tubers that we have found are Safford's (1919) of *lanceolata* and *auriculata*. Kellerman's illustrations of *glauca* tubers are fair (1900, fig. 1).

The tubers of *Smilax* were valued by the Indians as food, particularly in the southern states where the species with the largest and most fleshy ones are found. It is not possible to be certain just what species, as now understood, were meant by the older writers on this subject, but it is reasonable that the larger and less woody ones were most used. *Smilax lanceolata* is one of the two species having the largest and also the least tough tubers, the young ones being easily cut with a knife like a very firm, crisp apple. *Smilax auriculata* tubers are somewhat smaller but of about the same consistency and are quite large enough for use.

We have dug 12½ pounds from one plant at Myrtle Beach and then did not get all of it. Safford says that this species "was the principal source of a delicious jelly, called 'red coontie,' formerly prepared by the Indians of the southeastern United States from the fecula contained in its root stalks and tubers." *Smilax laurifolia* has very large tubers, which, though more woody, were probably also used. Any of these three could be beaten up and used for bread or mush after washing out the fiber. *Smilax* tubers are also said to be eaten by hogs (see *S. glauca*). Cattle are reported (Harper, 1928) to be fond of the leaves of *S. lanceolata*. The other two species with tubers, *Bona-nox* and *glauca*, have smaller and very hard, woody tubers, so much so that they show little shrinkage in drying. As the use of tubers as food by northern aborigines is mentioned, it would have to be one of these that was used, though much inferior to those of *lanceolata* and *auriculata*. The leaves of *Bona-nox* are said to be used by the Comanche Indians as cigarette wrappers.

The young shoots of robust species on emerging are used as a vegetable, and in Charleston they are brought in from the wild in their season and sold in the market like asparagus (see Lunz letter below). Porcher in his Resources (p. 616 of 2nd ed.), a treasury of information about the uses of our native plants, writes as follows about the uses of "China-Briar."

. . ."The decoction is alterative; in large doses, emetic. It is much used in portions of the Southern States in the composition of diet drinks, and it is considered one of the best substitutes for Sarsaparilla. Griffith Med. Bot. 660, states that the Indians employed the fecula of this, as well as that of the *S. caduca* [*rotundifolia*], *laurifolia* and *tamnoides* [*Bona-nox*], all of which are indigenous.

"The roots of this plant contain a good deal of Starch. They are, consequently, to a certain extent light and porous, and are used to make pipes with, also by our soldiers in camp in the manufacture of an extemporaneously prepared beer. The root is mixed with molasses and water in an open tub, a few seeds of parched corn or rice are added, and after a slight fermentation it is seasoned with sassafras. The young shoots of the China-briar are eaten as asparagus, with which they are closely allied. They impart the same odor to the urine, and probably contain *asparagine*.

"Lawson, in his 'Travels in Carolina,' says: 'The root is a round ball, which the Indians boil and eat.' Croom states in the notes to his 'Catalogue,' p. 48, that these roots become in time of scarcity an important article of food to the Southern Indians. The Seminoles, of Florida, obtain from them by maceration in water, their red meal, and from the roots of *Zamia integrifolia* their white meal, 'which have subsisted them in part during their late campaign.'

"Mr. W. G. Simms informs me that a rich brown dye is made from the roots with copperas.

"The seeds of the berries are exceedingly hard, and are used as beads. I have seen a necklace made with them resembling coral, which may well be called 'Indian coral'."

The plant above referred to as "China-Briar" is almost certainly *S. lanceolata* which is abundant around Charleston, Porcher's home, and is the one sold on the

market there. This is the more likely as *lanceolata* is the only species in his neighborhood that Porcher does not mention. He calls his China-Briar *S. pseudo-China*, a name much used for *lanceolata* in those days. The references by Lawson and by Croom may or may not apply to *lanceolata*.

Of Sarsaparilla (*S. glauca* in this case) Porcher discusses the medicinal values, and of *S. caduca* (our *rotundifolia*) he makes the interesting statement that "Some have asserted that it furnishes caoutchouc. See Hist. Nat. Pharm. ii, 590. The root affords a fecula." It would seem that this caoutchouc must have been obtained from the stretch-sac in the berries.

William Bartram in his *Travels* (p. 203 of 1928 ed.) writes as follows of an Indian feast: "We were graciously received, and treated with the utmost civility and hospitality: there was a noble entertainment and repast provided against our arrival, consisting of bear ribs, venison, varieties of fish, roasted turkies (which they call the white man's dish), hot corn cakes, and a very agreeable cooling sort of jelly, which they call conte: this is prepared from the root of the China briar (*Smilax pseudo-China;* . . .): they chop the roots in pieces, which are afterwards well pounded in a wooden mortar, then being mixed with clean water, in a tray or trough, they strain it through baskets; the sediment, which settles to the bottom of the second vessel, is afterwards dried in the open air, and is then a very fine reddish flour or meal: a small quantity of this mixed with warm water and sweetened with honey, when cool becomes a beautiful, delicious jelly, very nourishing and wholesome. They also mix it with fine corn flour, which being fried in fresh bear's oil makes very good hot cakes or fritters." This China Briar of Bartram, which he also calls *Smilax pseudo-China*, is evidently, as was the case with Porcher, our *S. lanceolata*.

Dr. G. Robert Lunz, Curator of Crustacea in the Charleston Museum, who has been of great help in guiding us around that section and doing much of the hard work in digging *Smilax*, in answer to some questions, writes the following letter:

"Both the rhizomes and the young growing tips of *Smilax* are eaten here. My father tells me that "Jack Brier" tips used to be eaten quite commonly here in the Low Country. Edward Manigault, one of the editors and owners of the News and Courier, tells me that he eats them regularly and furthermore the tips are sold on the market in Charleston each year. He doesn't remember exactly but thinks he paid ten to fifteen cents a bunch for the tips. They are cooked in the same manner as asparagus and Mr. Manigault tells me that it is a delicious food. From his description I suppose that he is talking about *lanceolata*.

"Neither Mr. Manigault nor Father knows about eating the roots but George Palmer, one the Museum janitors, tells me that eating the roots is a common practice in the vicinity of Eloree, S. C. George says he has eaten them many a time. The roots are eaten raw and taste 'kind'a stingy.' He calls them 'Chainey Brier' and says the vines and leaves are bluish while the roots are reddish. According to George the roots are eaten as an aphrodisiac, or to use his phraseology 'If you eat a little piece, it make your courage stand right now.'

"I can find nothing on pipe making. Mr. E. B. Chamberlain tells me that as a

boy he used to makes pipes out of the roots but we are not sure what species he used. Father says he has heard that some of the darkies used to make pipes from the roots. Mr. Manigault says that 30 years or more ago some darkies used the roots for pipe making up on the Santee River. George Palmer doesn't think they were ever commonly used. None seem to think they were very satisfactory pipes. As to what species was used for pipe making, it's hard to say. George probably has the best answer to that: he says that they used any brier root that was easy to shape and picked ones already shaped as a pipe."

It is interesting to find that as far back as 1731 Catesby writes of *Smilax*, "Of these roots the inhabitants of *Carolina* make a diet-drink, attributing great virtues to it in cleansing the blood, etc. They likewise in the Spring boil the tender shoots, and eat them prepared like asparagus. 'Tis called there *China* root." These observations of Catesby's are erroneously associated with his plate 52, which illustrates the herbaceous *S.* (*Nemexia*) *tamnifolia*. The quotation given almost certainly refers to *S. lanceolata* or *S. auriculata*, as he says the roots are tuberous and "when first dug out of the ground, are soft and juicy, but harden in the air to the consistence of wood."

The tubers, rhizomes (stolons or runners), and rootstocks are mentioned above as to form and general appearance and also under the various species. The roots are very much the same in all of them in fundamental structure and behavior. They are always of two conspicuously different kinds: (1) long, thick, permanent, and, so far as we have seen, unbranched except for (2) very delicate, crooked, shorter, and much branched laterals which arise from them and from the internodes and/or nodes of the stolons. The former spring only from the tubers and rootstocks and in some species from the nodes of the stolons. Both types of roots are alike in being very short-lived, apparently confining their vital activities to one season. The small ones disappear very quickly, but the larger ones, while dead, remain for many years, as represented by their hard, wire-like, very tough and strong central strands. Both types are very peculiar in that the thick, pulpy cortical layer is ephemeral and apparently almost entirely sloughs off by the end of the first season, leaving the lifeless, central strand to disappear after another season or so in the case of the small rootlets and to remain for many years in the case of the large roots (see Pl. 27, fig. 11, Pl. 38, fig. 2, Pl. 39). A very strange thing about this behavior is that the pulpy layer may be entirely dead and largely sloughed off from the proximal regions while the distal part may retain this layer in living, unchanged condition for a longer time. We have never seen any signs of root hairs on any of the roots of either type, but we have not yet sprouted any of the seed in water.

The aerial parts are so variable both as to regions and life stages that to the student the genus *Smilax* is one of his greatest puzzles. Even Fernald complains that from the books he cannot recognize the species in the field. If the entire plant, below and above ground, including ripe berries, is present, any species can be determined with certainty, unless something new is uncovered as in the case of the two new varieties here proposed. But when only a section of the stem with a few leaves from a certain part of the plant is at hand, the problem is

difficult and mistakes are often made. We have tried in this study to find ways to overcome these difficulties and help the puzzled student make a correct decision. Many important omissions and some errors are found in the manuals and other writings. These will be referred to under the species.

No mention seems to have been made by anyone of the fact that the aerial stems of all species are furnished in all parts with numerous stomata. Beneath the epidermis the cortical cells are green even though the surface may be very dark. On Plate 27, fig. 9, is shown the outer part of a section of the stem of *Bona-nox*. Here are shown a thick-walled epidermis, a subepidermal layer of colorless thick-walled cells and a cortical layer about five cells deep of thin-walled green parenchyma cells with small air spaces at the angles. There are a good many starch grains in these cells and the colorless parenchyma throughout the rest of the stem is well packed with starch. On the lower surface of the leaves the stomata are very numerous; on the upper surface, most species are without stomata. Holm reports them present on the upper surface of *S. hispida* and *rotundifolia*. We can confirm this for the latter, but have not yet found them in *hispida*. We have examined all our other species and find no stomata on the surface except in the case of *Walteri* (Pl. 30, fig. 8). In *auriculata* guard cells examined in green leaves (Jan. 1943, Charleston) contained large amounts of a fatty substance in the form of irregular globules that were quickly soluble in ether (Pl. 35, fig. 5). Similar fatty droplets were found in the guard cells of *S. lanceolata* (April 15, 1943) in an evergreen leaf of the previous year, and in tendril stomata of a new leaf (May 11, 1944) of the same species. Both fat and starch were found in about equal amounts (Pl. 34, figs. 2, 3).

The tendrils of *Smilax* when alive are bright green and in all species examined (*hispida*, *lanceolata*, *Bona-nox*, and *glauca*) have stomata. It seems odd, but we have not noticed any reference to stomata on tendrils of dicots. They must have been mentioned of course but textbooks seem to have ignored them. [We have just looked at a tendril of garden pea (*Pisum sativum*) and find them in abundance.] The guard cells in these tendril stomata of *Smilax* may be much longer than in the leaf and the stomata are sometimes placed side by side in pairs. The underground rhizomes of *rotundifolia* with no trace of green were examined for stomata with the following results: (1) distal joint with green tip out of ground, many stomata as usual; (2) next joint very pale green at distal end, many stomata; (3) next joint and following three (4, 5 and 6) with no trace of green, many recognizable stomata; joint No. 7, stomata mostly disorganized, leaving irregular holes in the epidermis. The stipular sheaths of young leaves are pale green, but so far as we have noted contain no stomata. In *lanceolata*, *auriculata*, *laurifolia* and probably in all high-climbing species, the first leaves on young ground shoots, which in all cases are reduced to scales, in undergoing the transition to complete leaves pass through a stage in which long, perfect tendrils are produced, while the blade is still nothing but an aborted little point (Pl. 34, fig. 11).

The length of life of an individual cane of a mature *Smilax* of fruiting age has never been discussed so far as we know and is apparently not known. In treat-

ing the several species we have in a few cases mentioned the fact that the canes may live for several years, up to three or four at least, and that in all cases, apparently, flowers are not produced until the second year or later. It is likely that in some species the canes may live longer than is obvious, and we are now labelling shoots to get evidence on this point. Labelling should have been started ten or more years ago. The length of time between seedling and fruiting age of any species has likewise never been ascertained. From our more or less casual observations, the time must be considerable, probably seven to ten years or more (see Pl. 27, figs. 11, 14, and Pl. 34, fig. 1). In immature plants as well as in mature ones aerial shoots are not habitually put up every year, and any one shoot may last several years.

The leaf of *Smilax* is an odd structure. Mrs. Arber (1920) has discussed the various views of the morphology and she subscribes to the view that the "blade of *Smilax* is not equivalent to the lamina of a dicotyledon but is merely a 'pseudolamina,' representing an expansion of the upper region of the petiole." This view also supposes the tendrils to be proliferations of the petiole and not homologous to tendrils of dicots, which are derived from stipules or blades. These views which are based on anatomy seem to us reasonable. The tendrils of *Smilax* do not derive from the petiolar sheaths (stipules?) but distinctly from the petioles just beyond them. Such explanations of the leaf morphology is called the phyllode theory, and there are some who hold that all monocot leaves are phyllodes and not homologous to the blades of dicots.

The "blade" in *Smilax* is shed in a peculiar manner. There is no abscission layer by which the leaf is neatly cut off as a whole, leaving a clean scar on the twig. Instead, the distal part of the petiole above the tendrils undergoes a soft disintegration and the "blade" falls, leaving a rough end on the stub. This might be considered a useful device, as the tendrils remain and continue to support the stem for years.

Flowers of all our woody species of *Smilax* are small, with little color, some quite fragrant, others practically odorless, none foetid. The male flowers are usually larger than the female (*havanensis* is an exception). The female flowers always have rudimentary filaments, representing the 6 stamens of the male. These vary considerably in size in the different species and also in different flowers of the same species. The smallest we have noted are in *S. Bona-nox* and *havanensis*, where they are only up to 0.5 mm. long and very narrow. The largest are in *S. laurifolia* (2 mm.) and *rotundifolia* and *californica* (1.5 mm.). Abnormalities we have happened to meet with are: 8 stamens in *S. Walteri* (Pl. 30, fig. 6); bisexual flowers in *rotundifolia* (Pl. 29, fig. 5); and flowers with two functional pistils in *S. californica* (Pl. 32, fig. 15). In *Smilax californica* we have also found unusual arrangements of the pedicels and branching of the pedicels (Pl. 32, figs. 12 and 16).

The anatomy of the Smilaxes is so very interesting that it should be treated far more fully than has been attempted in this paper. Our very sketchy notes simply suggest that there is need for careful study of the anatomy of this genus and the behavior of its roots. One of our students has written a master's thesis

on the development of the seed in *Smilax* and some interesting results have appeared. They will probably be published in a later issue of this Journal.

In the following groupings of the species, we have tried to indicate at least an approach to a more natural arrangement, based to a considerable extent on the underground parts, which have heretofore been very inadequately known.

Series I

Tricarpellate or by abortion only one or two functional carpels, normally with three styles, three stigmas and three ovules; more or less prickly, never tomentose (stem scurfy below in *Bona-nox*, but see its varieties); climbing; berries maturing the first season except in Group 4.

Group 1. Both tubers and long stolons present; leaves semi-evergreen; peduncles much longer than petioles; spines on both nodes and internodes of the aerial shoots
- glauca
- Bona-nox
- Bona-nox var. littoralis

Group 2. Long, unarmed stolons present but no tubers; leaves completely deciduous; peduncles shorter or little longer than petioles; no spines on nodes
- rotundifolia
- Walteri

Group 3. No tubers but long, armed or unarmed stolons present except in typical *hispida* and its var. *australis*; prickles slender and needle-like
- hispida
- hispida var. australis
- hispida var. montana
- californica

Group 4. Evergreen; no stolons but large tubers (in *havanensis* short knotty rootstock) present; peduncles as in Group 2; berries maturing in the second season or late in the first season or in tropical locations irregularly.
- laurifolia
- lanceolata
- auriculata
- havanensis

Series II

Ovary unicarpellate; one style, one stigma and one ovule; plant densely tomentose, unarmed, small and delicate, mainly prostrate; berries maturing the second season.
- pumila

In each of the five states beginning with South Carolina and going southward along the coast and through northern Florida to Louisiana, are found nine species of *Smilax* (all of those in the United States except *havanensis* and *californica*). This indicates that, while some species have ventured farther north, the milder zone of the southeastern Atlantic and Gulf states is the focus for our *Smilax* distribution. In Horry County, S. C., alone are found all of these nine species.

Two new varieties are herein described, *S. Bona-nox* var. *littoralis*, *S. hispida* var. *montana*, and one new authority citation made, *S. hispida* var. *australis* Norton *in* Small.

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GENERAL KEY TO THE WOODY SPECIES OF SMILAX—I

Plant small, scarcely climbing, softly pubescent, unarmed; berries bright red, pointed, maturing the second year ..... *S. pumila*
Plant larger, climbing, ours never pubescent
  Found only in California and Oregon; prickles slender and needle-like; peduncles much longer than petioles ..... *S. californica*
  Found only east of the Rocky Mountains
    Leaves conspicuously white-waxy (glaucous) beneath; peduncles much longer than the petioles; berry glaucous black, usually with 2-3 seeds ..... *S. glauca*
    Leaves not glaucous beneath or only slightly so
      Peduncles much longer than the petioles, very flat and pliable; berry black without a bloom
        Leaf margins roughened with minute cusps, not prickles; stem with delicate, needle-like prickles
          Berries small, with one, very rarely 2 seeds; underground runners (stolons) lacking
            Leaves ovate to cordate, none fiddle-shaped (pandurate) ..... *S. hispida*
            Leaves at least in some part of the plant, pandurate ..... *S. hispida* var. *australis*
          Berries varying in size in the same cluster, the larger ones with 3 seeds; hispid stolons present ..... *S. hispida* var. *montana*
        Leaf margins, except (usually) in upper and fruiting branches, with delicate, sharp prickles, otherwise the margin quite smooth; spines on stem stout and flattened; berries always one-seeded ..... *S. Bona-nox* and var. *littoralis*
      Peduncles shorter or not much longer than the petioles (rare exceptions in *S. rotundifolia*)
        Berries bright orange red or scarlet; leaves deciduous ..... *S. Walteri*

Berries dull brownish red (maroon) or black, with or without a bloom
Leaves evergreen
Leaves thin, the margins minutely roughened, nerves five (rarely seven); berries dull brown-red, ripening in summer of second year....*S. lanceolata*
Leaves thicker, the margins quite smooth
Leaves mostly pandurate or hastate or broadened and more or less abruptly pointed (cuneate) below, 3-5(7)-nerved; berries reddish purple to black, maturing late the first year, 1-3-seeded.....*S. auriculata*
Leaves never pandurate or hastate
Leaves broadly or narrowly elliptic to lanceolate, nerves only 3; berries black, maturing the second fall, one-seeded.....*S. laurifolia*
Leaves long-elliptic to ovate or suborbicular, with or without prickles; very veiny, main nerves 3 or 5; berries black, 2-3-seeded; confined in our area to southern Florida and the Keys.....*S. havanensis*
Leaves not evergreen
Leaves more or less ovate or rounded, the margins and often the petioles and midrib minutely or distinctly roughened; berries glaucous black, usually 2-3-seeded
Main stems and larger branches terete.....*S. rotundifolia*
Main stem and all branches quadrangular; petioles and midribs strongly roughened.....*S. rotundifolia* var. *quadrangularis*

KEY TO THE WOODY SPECIES OF SMILAX—II

(with reference to habitat)

Plant small, nearly prostrate, softly pubescent, unarmed; berries bright red, pointed, maturing the second year; lower coastal plain, S. C. to Texas.....*S. pumila*
Plant larger, climbing, ours never pubescent
Found only in California and Oregon; prickles slender and needle-like; peduncles much longer than the petioles.....*S. californica*
Found only east of the Rocky Mountains
Confined in our area to southern Florida and the Keys; spines on the stems very short and black-tipped; leaves thick and conspicuously veiny, very variable, narrow or broad and smooth or spiny.....*S. havanensis*
Not as above
Spines when present always *on nodes*, usually some also between nodes (in these and in all other species the spines becoming much smaller and often disappearing in the upper part of the plant)
Spines small and short, 2-4(5) mm. long, becoming very numerous toward the base of the cane and there reduced to delicate little prickles only 1-2 mm. long; leaves white-waxy (glaucous) beneath; coast to mountains.....*S. glauca*
Spines stouter and flattened at their base; leaves not white beneath
Spines up to 8-9 mm. long; leaves except in upper and fruiting branches usually prickly on margins and main veins
Stem in lower part harshly scurfy, and tubers spiny; upper coastal plain and piedmont.....*S. Bona-nox*
Stem smooth, not scurfy; tubers not spiny; coastal....*S. Bona-nox* var. *littoralis*
Spines when present never actually on the nodes (except rarely in *hispida* and *lanceolata*)*

* In *S. laurifolia* and *S. auriculata* the spines are often so numerous on the lower part of the stem as to crowd the nodes, but careful examination will show the actual nodes are avoided rather than otherwise.

Spines delicate, terete, needle-like (acicular), usually blackish, very numerous toward the base of the cane; leaves thin; no tubers produced and no runners except in *hispida* var. *montana*

Leaves ovate to cordate, pointed; piedmont and mountains
S. hispida and var. *montana*

Leaves at least in some parts of the plant fiddle-shaped (pandurate); coastal plain ..... *S. hispida* var. *australis*

Spines stout, up to 10–12 mm. long, flattened, at first green then blackish toward the tips; leaves not evergreen, very variable, typically ovate to roundish cordate, sometimes oblong or lanceolate, margins and larger veins and petioles usually finely roughened-nodulate (erose); canes always bright green, nearly terete except for the smaller twigs; long unarmed runners present but tubers lacking; common in coastal plain and lower piedmont ..... *S. rotundifolia*

As above but canes strongly 4-angled, the strong spines always on the angles; upper piedmont and mountains in south, also coastal sections in north
S. rotundifolia var. *quadrangularis*

Spines on strong canes very long and stout (up to 12 mm.), usually abundant, blackish on older parts; leaves evergreen, thick, quite smooth, usually broadly or narrowly lanceolate; primary nerves only 3; tubers large, but no runners; berries ripening the second year; edges of swamps and streams in the coastal plain
S. laurifolia

Spines few or many below (none upward), short, flattened; leaves pandurate (except near tips of twigs), evergreen, quite smooth, thick and very veiny; ripe berries dark, dull red (maroon) until late in the season, then purplish and finally black, tubers present but no runners; sandy coastal area ..... *S. auriculata*

Spines few and small (none upward); leaves not evergreen or panduare, thin, quite smooth; berries bright red; in mud or shallow water, inland coastal plain and sandhills (rarely lower piedmont) ..... *S. Walteri*

Spines usually few and small, rarely in stout canes large and much more numerous below; leaves evergreen, thin, usually lance-elliptic; ripe berries deep, dull red (maroon) to nearly black and with or without a bloom, ripening in summer of their second year; large tubers present but no runners; rich low grounds of coastal plain and rarely lower piedmont ..... *S. lanceolata*

KEY TO THE WOODY SPECIES OF SMILAX—III

(with emphasis on underground parts)

Plant small, nearly prostrate, softly pubescent, unarmed; berries bright red, pointed, maturing the second year ..... *S. pumila*

Plant larger, climbing, ours never pubescent

Found only in California and Oregon; prickles slender and needle-like; peduncles much longer than the petioles; tubers lacking ..... *S. californica*

Found only east of the Rocky Mountains

Confined in our area to southern Florida and the Keys; spines on the stems very short and black-tipped; leaves evergreen, thick and conspicuously veiny, very variable, narrow and spiny or broader and smooth or spiny; tubers and runners lacking
S. havanensis

Not as above

Rhizomes tuberous

Underground runners (stolons) also present; leaves not truly evergreen; berries maturing the first year

Leaves distinctly waxy-white beneath (glaucous); tubers without spines
S. glauca

Leaves not glaucous beneath
Tubers furnished with short, sharp spines; canes harshly scurfy below
S. Bona-nox
Tubers without spines, or largely so; canes not scurfy
S. Bona-nox var. *littoralis*
Underground runners lacking; leaves evergreen
Leaves thin, with 5(7) full length nerves; berries mostly 2-seeded, dull maroon red to nearly black, maturing the second summer ..... *S. lanceolata*
Leaves thick, with only 3 full length nerves; berries one-seeded, black, maturing in late summer or fall of the second year ..... *S. laurifolia*
Leaves thick, with 5 full length nerves in larger leaves, 3 in small ones; berries except smallest ones 2–3-seeded, dull reddish purple to nearly black, maturing late in the first year ..... *S. auriculata*
Rhizomes not tuberous; leaves not evergreen; berries maturing the first year
Underground runners absent or very short (less than 15 cm.); lower parts of aboveground stem usually densely prickly with slender dark bristles
Leaves ovate to ovate-lanceolate, none pandurate ..... *S. hispida*
Leaves, at least in part, pandurate ..... *S. hispida* var. *australis*
Underground runners present and often quite long
Underground runners and lower part of aboveground stem with numerous weak prickles ..... *S. hispida* var. *montana*
Underground runners free from prickles
Berries black, usually with a waxy bloom ..... *S. rotundifolia*
Berries bright red ..... *S. Walteri*

Smilax glauca Walter. Fl. Carol., p. 245. 1788.
S. spinulosa J. E. Smith *in* Rees, Cyclop. **33**: 1819. (Vol. 34 of 1st Amer. ed.)

Plates 9, 26, and Pl. 37, figs. 4, 5

Underground parts consisting of both tubers and long runners; tubers in the mountain form arranged in jointed rows and rather regularly ovate and smooth, of different sizes (e.g., about 3–5 x 2.5–3 cm.); in the piedmont and coastal form occurring in very irregular, knotty and compressed masses very much as in *Bona-nox* (Pl. 37, figs. 4, 5; see Kellerman, fig. 1, for photograph of this form); tubers not spiny in any form; runners with very small prickles between the nodes, and rather rarely on the nodes as well; internodes also furnished with numerous delicate, multi-branched rootlets, nodes more often without roots, but when present they are much stouter and less branched. Canes terete, green and more or less glaucous and purely vegetative the first year, mottled brown to very dark, and flowering on new lateral shoots the second year; the lower part thickly set with very short (1–5 mm.) slender spines between the nodes and somewhat stronger spines *on* the nodes, one or more on each side of the petiole. Upward the spines become somewhat stouter but not much if any longer and are gradually more scattered until they disappear in the fruiting part. Nodal spines nearly always present until the complete disappearance of spines above, and frequently to be found (one on each side of the petiole) after all internodal spines have disappeared. On the stouter parts the nodal spines usually more than two (three to six); all spines dark red-brown to nearly black and straight or slightly curved backward, especially at the nodes. Leaves prevailingly broadly ovate, short-pointed above and below, often mottled with pale areas as in *Bona-nox* and *lanceolata*, strongly glaucous beneath and entirely without cusps or prickles on the perfectly smooth margin, the veins below often reddish purple, the lower surface varying from entirely glabrous to distinctly roughened. Under a moderately high power this roughness is found to consist of little, broad, bluntly rounded,

unicellular papillae of varied sizes (up to 130μ long) which project from and are a part of the epidermal cells (Pl. 26, figs. 14, 15) and occur both on the veins and the blade between. As usual in *Smilax*, the leaves vary considerably in shape, sometimes broader than long (up to 9 cm. long, and 11 cm. broad) and somewhat heart-shaped, or much narrower and ovate-lanceolate, the first formed ones small, narrow and often more or less pandurate (see Kellermann, fig. 2, for various shapes and sizes of leaves). Peduncles flat, very slender, up to 3(3.8) cm. long, usually 1.5–3 times longer than the petioles; pedicels 4–10 mm. long; male flowers broadly campanulate, sepals and petals nearly alike, about 5 mm. long, oblong, pointed; stamens shorter than perianth, anthers linear, about as long as or longer than the filaments; female flower lobes narrowly lanceolate, about 3.5–4 mm. long; ovary ovate, 2 mm. long, glaucous; styles three, stigmatic only on the curved tips; buds of both sexes oblong-oval, not club-shaped, female smaller and more pointed than the male. Berries black with a bloom, tending to become shiny black in winter, subglobose, somewhat flattened from top to bottom (oblate), 8–10 mm. thick, sweet; young berries often obovate; seeds usually 3, somewhat flattened, very shining, brownish orange with a black eye. Flowering in early May in lower coastal plain of the Carolinas; in latter half of May and early June in upper coastal plain and piedmont, N. C.; mid- to late June in the southern mountains and Middle West; June and July in New England. Odor very slight or none.

Illustrations: Bailey. Cyclopedia of Horticulture, p. 3174. 1930.
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Kellerman. Ohio Nat. **1**: figs. 1 and 2. 1900.
Sargent. Garden and Forest **5**: 425, fig. 70. 1892.

Distributed from Massachusetts and New York southward through all the coastal states to Texas and in Arkansas, Oklahoma, Missouri, Kansas, Nebraska, Illinois, Indiana, Ohio, Kentucky and Tennessee; also in Mexico. Found in its various forms from the mountains (4000 ft.) to the sea, in either uplands or low grounds but seeming to prefer rather sandy or loose soil that is damp; most common in the shrubby borders of low fields.

To determine the geographical range of the two forms mentioned in the description will require a good deal more digging. The mountain form with potato-like tubers in chains is represented in our collections from Highlands and other stations in Macon County, N. C. The form with knotted and compacted tuber masses includes specimens from Chapel Hill (Orange Co.), N. C., Roanoke Island, N. C., Brookgreen (Georgetown Co.), S. C., and Mandarin (Duval Co.), Fla. Tubers shown by Kellerman for Ohio plants (fig. 1) are apparently like these. For variation in rootstocks of *S. glauca* on Staten Island, N. Y., see Davis (1891). What other differences, if any, these forms may show when growing side by side remain to be seen.

Easily distinguished by the glaucous leaves, slender, terete, dark stems with small, rigid spines, almost needle-like below, which when present at all are always found on the nodes, slender peduncles that are longer than the petioles, and glaucous (until old) berries with several seeds.

The leaves are almost entirely deciduous on old exposed vines, but when

growth is vigorous and somewhat protected, many of the leaves are retained throughout the winter, turning pretty colors with reddish and purple blotches. By midsummer many of the leaves are apt to show conspicuous circular yellow-brown eye-spots due to infection by a fungus.

Holm says that there are no stomata on the upper surface of the leaves of this species but that they do occur on that surface in *rotundifolia* and *hispida*. We have checked these observations and found them correct for this species and *rotundifolia*. We find stomata also on the upper surface of *Walteri*, but have not yet been able to find them on *hispida*.

Blake (1918) makes a new variety, *leurophylla*, of the form with leaves smooth beneath (p. 80), considering Walter's original as the rough-leaved form. He also gives this supposedly original form the varietal name *genuina*, which is uncalled for. He found no specimens in the various herbaria studied of the smooth-leaved form from South Carolina. In the herbarium of the University of North Carolina the species is represented as follows: the smooth form from Charleston, Myrtle Beach, Hartsville, and McCormick, S. C.; from Chapel Hill, Fayetteville, and Moore's Knob, N. C.; and from Kentucky; the rough form from Charleston and McCormick, S. C.; Macon, Polk, and Bladen counties, N. C.; also Jacksonville, Fla. Two specimens from Polk County, N. C., show one very rough and one slightly rough. The Charleston plants show 4 large ones with rough leaves, one young one with smooth leaves, all within 100 yards of each other. In the herbarium of Duke University the following examples have smooth leaves: Lexington Co., S. C.; Mass., La., Mo.; Pickens Co., S. C. (very delicately rough). The following have rough leaves (all N. C.): Roanoke Island, Durham Co., Orange Co., Forsyth Co., Haywood Co. (3 colls.). It will be seen from this that these forms cannot be separated in any regional way, and that designating these as varieties is not justifiable. Our material shows every gradation from absolutely smooth to distinctly rough. Conclusive evidence that this leaf character is not even a true ecological form is furnished by a single small plant from Americus, Ga., showing three over-wintered leaves, two leaves of usual size and form showing the very rough lower surface, the other smaller leaf on a different branch that is perfectly glabrous.

All canes of *glauca* that we have seen here or anywhere else have the lower part thickly set with very slender, acicular, slightly recurved spines, as described in *S. spinulosa* Smith. The species was proposed through lack of knowledge of the normal characters of *S. glauca*. Kellerman (p. 27) comes to the same conclusion. Standley (1920) considers *S. discolor* Schlecht (Linnaea **18**: 454. 1844) also a synonym of *S. glauca*, and *S. jalapensis* Schlecht (Ibid., p. 451) as probably so.

In Elliott, Pursh, and Willdenow, *S. glauca* is treated under *S. sarsaparilla*, a Linnean name that is no longer recognized. Porcher (p. 617 of 1869 ed.) gives *S. glauca* the common name of *Wild Sarsaparilla*. The true sarsaparilla of commerce is derived from the roots of several Central and South American species of *Smilax*.

Of all *Smilax* species this is the worst weed, due in large part to its deeply set

and very persistent tubers (see Kellerman, p. 25). Hogs are fond of the tubers and perhaps the best way to get rid of them is to turn the infested fields into a hog pasture for a few years.

Smilax Bona-nox L. Sp. Pl **2:** 1030. 1753.
S. tamnoides, sensu Chapman and A. Gray, not L.
S. renifolia Small. Fl. SE. U. S., p. 282. 1903.
S. variegata Walt. Fl. Carol., p. 244. 1788.

Plates 10 (below), 27, and 39

Underground parts consisting of woody tubers, single or pressed together into a compound mass like thick biscuits, the units up to 6 cm. thick, clusters up to 15 cm. across; also of long, stout runners ending in aerial canes and forming new tubers at nodes where branching occurs; older tubers by slow accretion giving rise to aerial canes. Tubers unique among all our species in being densely covered with short, thick, sharp or blunt spines with dark resinous tips and often forked like a deer's horn. Spines extending along the runners for a space on both the nodes and internodes, but on long runners usually entirely absent in the distal parts. Roots borne only on the nodes, never on the internodes; nodes, as in other species, covered on one side with large sheaths, abruptly contracted above the base to a lanceolate point. Aboveground canes stout, nearly terete, slightly lined below, strongly 4-angled or square and more or less zigzag above, distinguished by being covered below and often far upward with very short, stout warts that are crowned by a spreading mass of rigid, unicellular, white spinules or "hairs" (see photograph and fig.); also with very stout, flattened, rather long (4–9 mm. below, smaller and disappearing upward) brown or dark green spines with blackish tips which are clustered at the nodes and rather distantly scattered between. Nodal spines obviously structurally so, being set accurately along the stipular line, usually two large or many small ones on each side, reduced to one on each side before disappearing above; where the stems are roughened with spinulose warts the spines are apt to be also. Leaves very variable, usually thickish and often blotched with white, ovate-apiculate to broadly lanceolate, rounded or cordate and usually lobed below (pandurate or hastate, an extreme form being narrowly lanceolate with strong basal lobes), margins and main veins and petioles usually more or less prickly with delicate sharp spicules; petioles 7–15 mm. long. Male flowers with lobes 4–6 mm. long, filaments 3–4 mm. long, the anthers 1.4–1.8 mm.; pedicels 4–7 mm., peduncles 1.5–2.7 cm. long (as short as 5 mm. in an eastern Florida collection: Palmer, 1874, in N. Y. B. G.), flat and slender; female flowers usually rather numerous (10–20), smaller than the male, the lobes very narrow, 3–4 mm. long, styles short, often more or less fused in an irregular manner; ovary short-clavate; pedicels 3.5–10 mm.; peduncles flat, 1–3.4 cm. long (up to 5.1 cm. in specimen from Lake County, Fla.; Geo V. Nash, No. 563, April 1894, N. Y. B. G. Herb.). Berries spherical or at times ovate (Pl. 27, figs. 5–8), rather small, about 6 mm. thick, shining or dull, black, rarely a little glaucous, with one (very rarely two) large, red-brown seed with a black basal disk. Even when a third grown they are stretchy, as much so as when fully mature. Ripening in November in Chapel Hill. Flowering from early to late May in middle North Carolina; March 4, 1930, in Dade County, Fla.; April 25–30, 1894, in Kerr County, Texas.

A widely distributed species extending from Massachusetts (Gray), New Jersey, Maryland, southward through the Atlantic and Gulf States to Texas and

Mexico, and through Arkansas, Oklahoma, Missouri, Nebraska, Indiana, Kentucky, and Tennessee. In Florida it is listed to the Keys (Small), but this record very likely will be found to be var. *littoralis*. Norton (1916) and Britton (1918) report it from the Bermuda Islands. In the southeastern states it occurs in the upper coastal plain, piedmont and lower mountains (up to 2000 ft.). The coastal plant, which is plentiful, is probably all var. *littoralis*.

In *S. Bona-nox* the leaves in the upper parts are apt to be broader and larger and are usually entirely without prickles, the margins and veins perfectly smooth, as also the stems. Herbarium specimens consisting of such leaves only and the stem without prickles are easily confused with *rotundifolia* or *hispida*. Except in very rare cases the last two may be distinguished by their margins being roughened by little teeth or cusps, which even when unusually small may nearly always be detected under a lens. In *Bona-nox* the margin is thicker than the blade just behind it: margin 225 μ, blade 152 μ, in a large overwintering green leaf in Chapel Hill. In *S. lanceolata* and *auriculata* the loweer parts of strong canes are also rough but here this is caused by minute simple warts or cusps, not spinulose-hairy warts as in *Bona-nox*. Morong was apparently the first to notice these radiate-scurfy warts and mentions that he has also seen them in some cases on the veins of the leaf. Norton (1917) seems to have been the first to notice the *spiny tubers* of this species (see his fine photograph). For further comparison, see *S. auriculata*. In *Bona-nox* the leaves are tardily deciduous, particularly in regard to the upper larger ones which often survive the winter. The fresh *stem* (Coker Arboretum, March 29, 1943) contains great quantities of starch; stomal guard cells contain both starch and oil. Both upper and lower epidermal cells contain oil.

In the majority of the flowers the ovary is strictly one-celled and one-ovuled but many show traces of a 3-celled condition. Very rarely there are sections of the young ovary that will show three cells and three ovules. Others can be found with two good cells and ovules; and still others with one good cell and ovule with a second in various stages of abortion. It is obvious that the one-seeded condition has arisen by abortion from a 3-celled and 3-seeded ovary (see drawings).

Almost innumerable species, subspecies, varieties, and forms have been described that are now considered to belong to *Bona-nox*. It is possible that our var. *littoralis* might be referred to one of these forms if the descriptions were more complete. Willdenow describes as a species *hastata*, which DeCandolle treats as a sixth variety *hastata* under his subspecies 4(polyodonta) of *Bona-nox*. As this plant is reported as occurring in maritime Carolina and Florida, it is not at all impossible that it is our variety, but there is nothing in the description to verify this, as neither of the diagnostic characters, the unarmed tubers and runners and the smooth, not nodulate-scurfy stem, is mentioned. Willdenow does say of the stem "subinermi" and he quotes from Plukenet "stipite quadrato leni," but this use of the word smooth evidently refers to a lack of prickles, not scurf, which was first noted by Morong as mentioned above.

Small's Illustrated Flora (1933) still carries *S. renifolia* as a species, but the

type in the New York Botanical Garden shows it to be *Bona-nox*, as originally labelled by Heller, the collector, and as noted in pencil by Norton. The leaf shape is not unknown in *Bona-nox* and is most often seen in the Texas form. The thin leaf is probably due to shade.

In the Cuban material sent us by Dr. Bruner (see also under *havanensis* and *laurifolia*) there is an unidentified plant that looks like *Bona-nox* but the collection has leaves only. The leaves have numerous very small slender prickles on the margin and some on the principal veins beneath, and are more or less strongly hastate; stem subquadrate with rather few, delicate, pale prickles both on the nodes and internodes. The label reads: Herbarium de Cuba, Estacion Central Agronomica, No. 11745, Smilax, Fecha April 1910, Provincia de la Habana. So far as we know, *Bona-nox* is not recorded from any of the West Indies. Flowers, fruits, and underground parts of this Cuban plant are needed.

Smilax Bona-nox var. **littoralis** n. var.

Plates 11 and 28

Tubers without spines, and after a few months lead gray; stolons with few or no spines; aerial canes entirely without scurfy "hairs." Otherwise as in the species.

Type: Myrtle Beach, S. C., July 2, 1942; W. C. Coker and B. E. Smith.

The canes have spines or stout prickles both on and between the nodes and are distinctly angled (except at base), the terminal branchlets strongly zigzag and nearly square, just as in *auriculata*. The stolons, which are of moderate length, are light gray-green to nearly white, almost without spines; roots when present occurring only at the nodes. Flowering April 22, 1943, Charleston, S. C., May 10, 1943, Georgetown, S. C.; May 11, 1941, Horry County, S. C.; May 2, 1944, Hartsville, S. C. (cultivated). Berries as also in the species, remarkably uniform in size and shape, about 6 mm. thick and 7 mm. long, ripening shining or dull black and going over the winter without withering, one-seeded. A cane may bear two sets of berries on different branchlets, one lot young and of the present season, another long ripe and carried over from the preceding season. The young berries are conspicuously oblong (Pl. 28, fig. 6), as is often the case in other species, even though the ripe berries are spherical or nearly so.

This represents the typical variety as it occurs at Myrtle Beach, S. C. It is probably, with some modifications, the coastal form of the species in the southeast. In January, 1943, we collected a number of *Bona-nox* plants from the suburbs of Charleston and Rockville, S. C., and found them more or less intermediate between the typical species and the Myrtle Beach variety. Some were almost free of spines on tubers or of nodules on stems, in some there were rather short spines on the tubers and nodules on stem, but all these nodules were without the scurfy spinules of the species. A plant from Penney Farms (Clay Co.), Fla., received from Maj. and Mrs. H. R. Totten, March, 1943, was like the Myrtle Beach variety: 3 or 4 little spines 0.5–1.5 mm. long on the entire underground system (tubers and stolons) and no scurf on canes. Another from Duval

Co., Fla., July 1, 1943 (Lee Adams, coll.) was entirely free of spines on the underground parts and canes quite smooth. We also have good flowering and fruiting plants of the variety from Brookgreen, Georgetown Co., S. C. (F. G. Tarbox, coll.). A number of other collections made during June 1944 at Myrtle Beach showed characters exactly like those of the type of the variety. Of the many plants examined, only one had the lower part of the stem slightly harsh to the fingers, no roughness visible to the eye.

Much more digging will have to be done along our extensive coast line before the forms of this area are adequately understood.

As evidence that the variety is a distinct and well established unit and not a mere temporary variant due to some environmental factors, we record the case of a plant brought up from Myrtle Beach in the fall of 1934, and planted in the Lakeside Park of Coker College, Hartsville, Darlington Co., S. C. In this and adjoining counties the native form of *Bona-nox* is the typical species in all characters. After nine years of vigorous growth the Myrtle Beach plant is sending up shoots over an area of 8–10 feet in diameter and was in full bloom (male) on May 2, 1944. The plant has retained all the features of the type from Myrtle Beach; rather small, hard, gray-brown tubers, both tubers and stolons completely unarmed; aerial stems all entirely without the conspicuous scurf of the typical *Bona-nox*; spines on nodes as usual.

Smilax rotundifolia L. Sp. Pl. **2:** 1030. 1753.
S. caduca L. Sp. Pl. **2:** 1030. 1753.

Plates 12 and 29

Underground stems consisting altogether of long, usually slender, entirely glabrous runners (a few small prickles may sometimes be found in var. *quadrangularis*) usually near the surface, that root only at the nodes; the internodes about 4–9 cm. long; in proximal parts of stouter runners the nodes sometimes swollen like arthritic finger joints, but the internodes still obvious and distinctly smaller than the nodes, and there are no real tubers or strongly swollen masses. Canes green at all ages, stout or slender, climbing rather high, 15–20 feet, or forming tangled thickets of more slender growth, main stem and larger branches round (not angled) in the typical coastal and lower piedmont form, strongly angled to almost square in var. *quadrangularis*, the ultimate branches square in all forms. Spines stout, straight, flat, up to 12 mm. long, pale greenish with dark or light tips, numerous but not crowded, fading out upward, *never on the nodes*. Leaves very variable in shape, broadly ovate (usually) to ovate-lanceolate, the tip abruptly pointed, base rounded to cordate, blade up to 16 cm. long and 17 cm. wide, usually about one half that size; margin and larger veins below and often the petioles minutely or strongly roughened with little pale, multicellular, usually blunt teeth or cusps up to 0.5+ mm. long, several of the terminal cells often more or less papillate (Pl. 29, fig. 14); surface of the leaf otherwise smooth, the lower shining; petiole 0.5–1.5 cm. long, upper half of petiole and larger veins often reddish; first formed leaves at base small and narrow and usually with more or less prominent basal lobes (auriculate or pandurate).

Peduncles very variable in length, usually a little shorter or a little longer than the petioles, but at times nearly three times as long (up to 3 cm.), rarely as short

as 3 mm.; flowers pale greenish-yellow but in the male and to a less extent in the female the buds often tinted with red-brown both at tip and base or almost all over; pedicels of the male flowers about 7–10 mm. long, the lobes strap-shaped, pointed, recurved above the middle, anthers barely exserted, about half as long as the filaments; female flowers somewhat smaller, the three styles very prominent. Berry black with a bloom (glaucous) or shiny black on much exposure, very rarely a dull brownish red (maroon); seeds two or three. Flowering in Chapel Hill from mid-April to late May, about mid-June on Nantucket Island.

Illustrations: Audubon. Birds of America **4:** pl. 237. 1842 (Pl. 57 of 1937 ed.)
Britton and Brown. Illus. Flora **1:** 440. 1896.
Clements et al. Minnesota Trees and Shrubs, p. 299. 1912.
Deam. Shrubs of Indiana, pl. 5.
Holm. Mem. Torr. Bot. Club **2:** pl. 15, figs. 105–122. 1891.
National Geog. Mag. **35:** pl. 2. 1919.

In its different forms this is one of the most widely distributed of our species of *Smilax*, occurring from coast to mountains from Nova Scotia southward and westward through all the states to Texas, Oklahoma, Arkansas, Missouri, Kansas, Iowa, Minnesota and South Dakota, also in Ontario and Nova Scotia. In Florida it extends to the upper part of the peninsula. It is especially abundant in low flat woods and damp depressions where it forms tangled thickets that are very troublesome to hunters. In the southern mountains it is very robust, with strongly angled stems, and this is the form that has been called var. *quadrangularis* (Muhl.) Wood. The variety differs strikingly from what we consider the typical form in the squareness of the stems, which are markedly so throughout, even to the ground and this character is so pronounced as to extend even to the underground runners, a fact that we have not seen mentioned heretofore. There are, however, intergrading forms between this and the coastal and lower piedmont form with terete canes and runners. Plants from Nova Scotia, from Cambridge, Mass., and from Alexander County, Ill., in the New York Botanical Garden are just like our southern typical form.

The plant on Nantucket Island described by Bicknell (1909) as *S. rotundifolia* var. *quadrangularis* is not just like our mountain plant described above. Both have the strongly erose leaf nerves and margins, also the strong tendency of the first formed leaves to be pandurate. His plant, however, is said to be more dwarfish and little-climbing, whereas our mountain one is very robust and high-climbing. This indicates what is to be expected, that there is more variation than is generally supposed. It is to be noted that our coastal and piedmont form with terete main stems also has erose leaf margins, though this character is not so prominent as in var. *quadrangularis*.

The species is distinguished from *hispida* with which it is often confused by: (1) the larger, flat, not crowded spines, entirely lacking the numerous needle-like, usually blackish prickles on the lower part of the stem which are characteristic of the latter species; (2) the larger, blue-black berries with 2 or 3 seeds and on shorter peduncles, and (3) the presence of long runners, which are absent in *hispida* except in the var. *montana* in which they are densely prickly, not glabrous. For comparison with *Bona-nox*, see that species.

The var. *crenulata* Small and Heller (Mem. Torr. Bot. Club **3:** 17. 1892), described from Grandfather Mt., N. C., and later from Tallulah Falls, Ga. (Bull. Torr. Bot. Club **21:** 301. 1894), has lanceolate to ovate-lanceolate leaves and strongly nodular and crenulate margins. We have what exactly corresponds to this variety, found under dense shrubbery at Highlands, N. C. The leaves are very thin and the margins more erose than usual. At best the distinguishing characters are minor and very variable and we have a series of intermediates. The form had best be considered as an ecological variant.

From Holm's treatment (Mem. Torr. Bot. Club **2:** 80, figs. 111–112. 1891) one would suppose that this species had sizable tubers. His fig. 112 shows a rhizome with somewhat tuberous swellings, but this must have been a very young, small plant. Old ones have long, branched, slender runners with no real tubers, the branches and canes arising from joints just swollen enough to hold them. Holm calls attention to the dentations on the margins of *rotundifolia* and *hispida*, but does not mention them on the veins in either case.

Smilax Walteri Pursh. Fl. N. Amer. **1:** 249. 1814.

Plate 30 and Pl. 38, fig. 3

Rhizomes slender, running extensively without tubers or spines and rooting only at the nodes. Canes rather delicate, climbing only 15–20 feet, reddish the first year then darker brown, more or less angled, spines small, flat, not numerous, about 1.5–3 (4) mm. long, usually absent above. Leaves broadly or narrowly ovate-lanceolate, mucronate, rounded or rarely subcordate below, 2–5 x 4.5–7 cm., more uniform in shape than in any other species except *pumila;* petioles 5–10 mm. long. Male flowers with broadly recurved lobes about 6 mm. long, the peduncles 3–6 mm. long and pedicels 3–6 mm. long; female flowers smaller with less recurved lobes, ovary oval with long (3 mm.), slender styles; the peduncle in fruit flat, 3–20 (25) mm., the pedicels 3–8 mm. long. (In a peculiar plant from Mississippi, Seymour and Earle, No. 147, the male flowers have peduncles 0.5–2 mm. long, the pedicels 10–12 mm.). Berries bright coral or orange red, shining, 7–9 mm. thick, spherical or rarely ovate with a small blunt point (Pl. 30, fig. 3), or more or less obovate (fig. 4) or variable on the same plant (fig. 7), ripening in October of the first season and remaining plump and bright through the winter and sometimes even into the summer; seeds 1–3, more often one or two, dull red. Flowering in April and May in the southern coastal plain, May in the piedmont, and June in New Jersey.

Illustration: Britton and Brown. Illus. Flora **1:** 442.

Growing in wet, sandy margins of streams and ponds, or even in water at least a foot deep. It occurs from southern New Jersey (pine barrens) and Maryland southward in the coastal plain, rarely lower piedmont, to upper peninsula Florida, Louisiana, and Arkansas; rather frequent in the upper coastal plain, particularly in the sandhills, becoming scarcer toward the coast where it is very rare (we have it from Brookgreen, S. C., only a mile or so from the ocean), occasional in lower piedmont, as in Durham and Chatham counties, N. C., and has been collected in northeastern Georgia (Habersham Co., J. K. Small, N. Y. B. G. Herb.) near Tallulah Falls, a very surprising record. The

Arkansas record is new. We find a sheet of it in the New York Botanical Garden Herbarium from a swamp at Hot Springs, Ark., that was mislabelled *rotundifolia*. It is not an abundant plant anywhere but the brilliant berries make it conspicuous in swamps in winter.

The pointed form of berry is quite rare. It has been found twice at Hartsville, S. C.,—once by Dr. Velma Matthews, Oct. 19, 1934, and again by a negro boy who sold such berries to Mrs. C. W. Coker for Christmas decorations in 1940. Walter, who first found this species, thought it might be *S. China* (p. 245), and described the berries as acuminate ("baccis rubris acuminatis trispermis"). Pursh (vol. **1**: 249) names the plant for Walter and repeats "berries acuminate and red." Elliott (vol. **2**: 697) never saw *S. Walteri*, which shows its rarity on the coast, and repeats Walter and Pursh. Wood is the first to note the prevailing shape, saying "globular and oblong-acuminate."

Ravenel writing to Gibbes on Jan. 14 (no year given) seemed worried about these descriptions of acuminate berries in this species, and about the "3-seeded" statement by Walter, but he had by then found some with three seeds. The finding of pointed berries by Wood and later at Hartsville clears up this last difficulty. (See copy of Ravenel's letter in the Botany Department, University of North Carolina, from original in the Charleston Museum.) The acuminate berries are certainly much rarer than the globular ones, but Walter must have got hold of such a form. Norton (1930) says that white-berried sports of *Walteri* are known. Mohr (1901) says, in error, that the fruit of *Walteri* matures the second year.

We have found that in this species, as in a few others, scattered stomata occur on the upper surface of the leaf.

Smilax hispida Muhl. in Torrey, Fl. N. Y. **2**: 302. 1843.
S. grandifolia Buckley, Amer. Journ. Sci., Ser. I, **45**: 171. 1843.

Plate 31, figs. 1–6

High climbing vines of rich woods and along streams; underground stems without tubers or runners of any length, consisting of a very short, small, knotty root-stock on which the aerial canes are closely set, with rarely a short offset (up to 3–4 inches) starting a new node with aerial shoots; all underground parts quite free from the prickles so abundant on the lower part of the exposed stem. Upper, fruiting parts also quite free of prickles, rather obscurely 4-angled; lower part of canes not angled, rather densely set on the internodes and not rarely also on the nodes with slender, usually blackish, nearly terete, needle-like, straight prickles from 1–8 mm. long, the various lengths intermingled. Leaves prevailingly ovate-lanceolate, always pointed, the base abruptly rounded or cordate, varying greatly in size, up to 13 cm. long and 10 cm. broad, thin, green on both sides, with 5–7 obvious nerves; margins and larger nerves below roughened with minute, tooth-like nodules (as in *rotundifolia*). Male flowers broadly recurved with a spread of about 7–8 mm., lobes narrowly strap-shaped, about 7 mm. long, the anthers 2 mm. long, the filaments about 4 mm.; peduncles about 12–21 mm. long, very slender; pedicels 5–10 mm. Female flowers rather numerous (up to 25), smaller than the male, petals only 3.5 mm. long, deep green; ovary oval, with 3 cavities, one or two usually aborting, stigmas 3(4 seen once);

peduncles about 1–4(5) cm. long, average about 2.5–3 cm., slender and much flattened; pedicels 4–8 mm. long. Berries 6–8(−10) mm. thick, many (up to 25) in a cluster, ripening black (not glaucous) the first season; seeds usually one, rarely two, red-brown. Flowering in May or early June (May 16–24, 1943, in Chapel Hill).

Illustrations: Bailey. Cyclop. Horticulture, p. 3174. 1930.
Deam. Shrubs of Indiana, pl. 6. 1924.

This species occurs from Connecticut, New York, and Pennsylvania southward to Georgia (Gwinnett County), Alabama (Etowah and Lea counties), Mississippi, Louisiana, and Texas, Arkansas, Oklahoma, Missouri, Kansas, Nebraska (Lincoln; H. J. Webber, N. Y. B. G.), Iowa, South Dakota, Minnesota, Michigan, and on into Canada; in the central states east of the Mississippi, in Illinois, Indiana, Ohio, West Virginia, Kentucky, and Tennessee. In the South Atlantic and Gulf States, it is a plant of the piedmont and mountains. The only record we find of typical *hispida* in the coastal plain is by Fernald (1938, 1941) who found it in several counties in southeastern Virginia, together with a number of other more piedmont plants which have extended down into this region. Our specimens from South Carolina so far are all of the var. *australis*, and it is possible that the records from Mississippi and Louisiana might also come under this variety.

The species does not seem to be rare in the northern and middle western states, but is not common in the southern states, although reported from all of them except South Carolina and Florida. In North Carolina we have seen *hispida*, including var. *montana*, only from Orange, Wake, Rutherford, Surry, Macon, Clay, Haywood, Buncombe, and Burke counties. It has been reported to us by letter from a few other places in the state, but it seems to be our rarest species. Curtis (1860) does not include it in his list of North Carolina smilaxes. In Macon and Clay counties the above records are for the var. *montana*. It is quite probable that certain specimens seen from the other counties are also of this variety, as that cannot be distinguished except by fruit or rooting parts. The Orange County plant is the typical species.

This fine vine is easily distinguished from all other species by its slender, weak, blackish prickles, thickly set on the lower parts of the canes above ground. (In *glauca* the lower prickles are very small, but they are paler, flattened at base and much more rigid.) Where the prickles are numerous they may occur on the nodes, but on fading out upward they first leave the nodes, the reverse of what occurs in *Bona-nox* and *glauca*. From *glauca* it is of course easily distinguished by leaves green on both sides and with rough margins, as well as by the absence of underground tubers. For comparison with *S. rotundifolia*, see that species. For notes on stomata in the tendrils of *S. hispida* and several other species, see the Introduction; see also Pl. 34, fig. 2.

In small young plants of *hispida* we have found that the prickles may be nearly or entirely lacking. We have found two such specimens from near Chapel Hill, one 6 inches high with five leaves that has no prickles, the other three feet high that has only four prickles on the first foot, very few on the middle

and none on the upper foot. In a local plant grown in the University of North Carolina shrub garden a shoot from the ground in 1942 flowered on the new laterals in 1943.

On the authority of De Candolle and the Kew Index we are listing *S. grandifolia* Buckley as a synonym. Buckley does not mention the rooting parts and his plant may have been what we are calling var. *montana*, as he found it in the mountains of North Carolina and in Alabama. He describes the flowers as "reddish brown," a color not mentioned elsewhere, so far as we know, for any *Smilax*. However, we have noticed that particularly in the male flowers of *S. hispida* and also of *S. rotundifolia* the large buds are frequently distinctly red-brown over the upper third and somewhat brownish below. In some cases this color may be extended almost to cover the bud.

In older works this species often passed under the name of *Pseudo-China*, a name also much used for *Bona-nox*.

Smilax hispida var. **australis** Norton in Small. Man. S. Fl., p. 312. 1933.

Plate 13 and Pl. 31, figs. 7-12

This variety differs from typical *hispida* in its pandurate leaves. Not all of the leaves are pandurate, but there are nearly always some such on each cane. In other respects the plant is like *hispida*,—no runners or real tubers, one-seeded berries, leaves with nodulate margins, close-set, delicate, acicular prickles on lower part of canes. The largest rootstock we have found is about 6 x 7 x 2.5 cm., irregular and very hard and woody. Male flowers strongly recurved with a spread of about 6 mm., lobes about 5.5 mm. long, filaments 3 mm. long, anthers 2.5 mm. long; pedicels 7–10 mm. long. Peduncles of female flowers about 2–3.5 cm. long (average of 27 measured was 2.75 cm.). Flowering May 23, 1943, in Chapel Hill (cultivated from Thomasville, Ga.), and in mid-April, 1893 and 1894, in Duval County, Fla.

In its extreme forms the leaves are characteristic in shape: the broad and rounded basal lobes and narrow distal extension being unlike those of any other species.

This variety is the low country form, extending from the sand hills to the coast. Norton in his map (see below) shows the distribution of the "formal variety" (presumably var. *australis*) along the Gulf and Atlantic seaboard from Texas to the Carolinas, not approaching the area of typical *hispida* except in Texas, where, according to him, it originated. His map of the typical *hispida* area does not at any point approach the coastal plain. We have specimens of this variety from Darlington, Orangeburg, Horry, and Georgetown counties in South Carolina, from Thomasville, Ga., and from Duval County, Fla.

In the New York Botanical Garden the var. *australis* is represented from Florida by the following collections: Chapman (as *Pseudo-China*), Nash (as *Bona-nox?*), Torrey and Gray, Flora of North America (as *Pseudo-China*), Burrows (Tampa Bay, as *tamnoides* var. *pandurata*), Curtis (Jacksonville, as *Bona-nox*).

Smilax hispida var. *australis* has never been adequately published. It has been included as a considerable element of composite descriptions under the

caption of *Pseudo-China*, with elements of *Bona-nox* or *hispida* thrown in. For examples, see Morong, Britton and Brown, Gray's Manual. Chapman's description of *Pseudo-China* is correct for this variety except that the berries are nearly always one-seeded. In describing the variations of *S. hispida* Small simply interjects it in parenthesis as "hastate or pandurate in *S. hispida australis*," with no authority given. Norton (1916), in explanation of his map, mentions a "formal variety," no name, of *hispida*, but in the herbarium of the New York Botanical Garden there are a number of sheets of *S. hispida* labelled var. *australis* and signed "J. B. N." Norton, as is well known, was the American authority on *Smilax* and was preparing an extensive monograph on the genus. He contributed the treatment of *Smilax* for Bailey's Cyclopedia of Horticulture. It is to me obvious that when Small was preparing the manuscript for his Manual, he evidently knew of Norton's work and collections and had expected the variety *australis* to be published by Norton before the Manual appeared. In view of these facts it seems to us that in order to do justice to both men we might refer to the variety as "Norton in Small."

In consultation with Mr. Wittrock and Mr. Alexander we have selected as type the sheet by Nash mentioned above, which is labelled thus: "Plants of Florida. Collected at Lake City, Columbia County, by Geo. V. Nash, July 11–19, 1895. 2237a *Smilax Bona-nox* L.?" Above the label in handwriting there is in pencil: "Not *Bona-nox* but *hispida australis* S. n. sp. (Floridan *Pseudo-China*)."

Smilax hispida var. **montana** n. var.

Plates 14–16 and Pl. 31, fig. 13

On the southeast side of Shortoff Mountain, Macon County, N. C. (elevation about 4500 ft.; type station), on the east face of Mt. Satulah, also in Macon County (elevation about 4400 ft.), and on a rich wooded slope in the eastern part of Clay County, N. C., at a lower altitude, we have found a *Smilax* of the *hispida* group which differs markedly from the typical *hispida* in several important respects, and we are treating it as a new variety, described as follows.

Primary rootstock (as in *hispida*) short, black, woody, thickly covered with long, stout roots, but differing from the typical in giving rise to one or several long (up to 8–10 ft.), stout or slender, densely to sparsely armed, at times unarmed, runners, usually without but sometimes with enlarged rooting joints often with aerial shoots; berries large, few in a cluster, round or oblate-flattened and many containing two or three seeds; peduncles (as far as seen) averaging only 1.8 cm. Aerial stems and leaves as in typical *hispida*.

The underground parts may be quite complicated, the primary runners giving off long or short branch runners, the swollen rooting joints occurring here and there apparently without any order. On the larger runners the leaf scales are conspicuous, the tips and sides wearing away, leaving a fringe of fibrovascular bundles. Berries were found only on the Shortoff Mountain plant. They were fully ripe on Sept. 5, 1939. At that date the leaves were fading and turning

color. That the berries were ripe so early indicates that the time from flower to mature fruit is shorter than in any other of our species. The growing season at this high altitude is short, and while we have not yet seen the flowers it is certain that they did not bloom very early. In all our smilaxes the flowers are borne on wood of the season. On July 17, 1939, the green berries, somewhat flattened by drying in the press, were already 6.5 mm. wide, showing that they had grown rapidly.

Type in U. N. C. Herb.; cotype in N. Y. B. G. Herb.

Gray's Manual says *hispida* has a cylindrical, elongated root stock. It is hard to understand this statement unless the author had seen a plant of our var. *montana*. It is of course quite possible that some reports of *hispida* may really apply to this variety, as the underground parts are rarely mentioned.

North Carolina. Macon County. Shortoff Mt., July 17 and Sept. 5, 1939; Mt. Satulah, Aug. 19 and Aug. 27, 1943.
Clay County. Between Buck Creek and Perry Gap, Aug. 25, 1942.

Smilax californica (A. DC.) A. Gray *in* Brew. and Wats. Bot. Calif. **2:** 186. 1880.
S. rotundifolia var. *californica* A. DC. Monog. Phan. **1:** 75. 1878.

Plates 17, 18, and Pl. 32, figs. 11–16

As we have seen this plant only in herbaria we take the following from Abrams (Ill. Fl. Pacific States **1:** 459. 1923).

Stem woody, terete or somewhat angled, more or less covered with slender straight spreading brownish prickles, sometimes nearly or quite naked. Leaves broadly ovate, 5–10 cm. long, 25–70 mm. wide, abruptly acute and apiculate at apex, sub-cordate at base, rather thin, glabrous, deciduous; petioles 10–15 mm. long; peduncles slender, flat, 2–5 cm. long; pedicels 8–20, 6–8 mm. long; staminate flowers with ligulate perianth-segments about 5 mm. long, 1 mm. wide; widely spreading and recurved from below the middle; stamens 3 mm. long; berry black, 6 mm. in diameter.

Stream banks, climbing bushes and small trees often to a height of several feet. Upper Sonoran and Transition Zones; southern Oregon to Butte County, California. Type locality: near Chico, California.

Illustration: Abrams. Illus. Fl. Pacific States **1:** 459. 1923.

Probably because of the shape of the leaves this species was first treated as *S. rotundifolia* with a question and later as a variety of that species by De Candolle. Norton (1916) placed it in the *hispida* group and no doubt correctly so. According to his conclusions the *hispida* group entered America from the west while *rotundifolia* came from the east. Kinship to *hispida* is indicated by the delicate, needle-like spinules, the long peduncles and the black (not glaucous), 1-2-seeded berries. The underground parts have not been described, but through the kindness of Dr. Abrams and of the Dudley Herbarium of Stanford University we have received two sheets of this species that show clearly that very distinct underground runners are formed. In both cases the runners are entirely without prickles and in the dried state blackish, with many longitudinal

ridges; one 3 mm. thick, the other 7 mm. The roots are formed only at the nodes. In one case three consecutive nodes each gave rise to aboveground shoots; in the other, showing three nodes, a shoot was formed from only one node. This shoot evidently ran for about 20 cm. underneath the humus before finally emerging at its tip, but it is evidently not of the rhizome type but of the foliose, as is shown by the absence of roots, greenish color and numerous fine prickles, starting almost at the base.

Comparing our eastern mountain variety of *hispida*, it will be noticed that its larger underground runners are abundantly supplied with prickles, while some of the smaller ones are completely free of them.

From specimens in the New York Botanical Garden we find that in one case the male pedicels are up to 1.5 cm., most about 1.1–1.3 cm. long; peduncles about 4 cm. long; leaves thin with pale yellowish veins as in *hispida*; flowering June 20, 1940. In another case (female) ovaries ovate, large, 2.5 mm. long; styles three, long; flowering June 1903. In the specimens seen, most of the leaves have margins minutely roughened under a lens, as in *hispida*. In our Plate 32, fig. 16, it will be seen that one of the pedicels is bearing two berries and in fig. 15 are shown two perfect pistils in one flower, the only case we have ever seen in any species. Deam (1932) says of *hispida* "rarely a pedicel with 2 or 3 flowers and maturing two berries."

Smilax laurifolia L. Sp. Pl. **2**: 1030. 1753.
? S. alba Pursh. Fl. N. Amer. **1**: 250. 1814.

Plates 10 (above), 19, 33, and Pl. 37, figs. 1–3

Canes up to 1.5 cm. thick; spines abundant in the lower part, stout, flattened, black, up to 1.2 cm. long, very irregularly set, usually not any on the nodes and when so not set on the stipular line; lower internodes often over a foot long; under, ground part composed of a densely packed, more or less rounded mass of thickly branched, heavy, very hard and woody rhizome sections with reddish surface and the younger sections covered with larger papery red scales; the whole surrounded by a great number of long, thick, pale roots with few branches; color of cut sections of rhizome pinkish red, about fawn color when fresh (about same as in *lanceolata*). Leaves evergreen, thick and leathery and with only three nerves, quite glabrous and smooth throughout, usually oblong-elliptic to lance-elliptic but varying greatly from broadly ovate to linear (the extreme of the latter shape being var. *bupleurifolia* Delile). Peduncles shorter or a little longer than the petioles (1–8 mm.), pedicels 2–6 mm., flowers small, usually numerous, crowded; lobes of the male narrow, about 4 mm. long, stamens about as long as the petals; lobes of the female lance-elliptic, about 2–2.5 mm. long; ovary two- or three-carpellate (about half and half) but nearly always one-celled and one-seeded by abortion (Pl. 37, figs. 1–3); stigmas two or three, short, thick, fused at base, quickly deciduous leaving a single, flat, circular scar. Berries shining black, or when young or newly ripe, glaucous, 5–7 mm. thick, ripening from mid-summer to fall of the second year and lasting through the second winter, spring, summer and even fall without shrivelling, about 5–25, usually 6–12, in a cluster; seed one, rarely two. Flowering Aug. 15, 1939, and Sept. 2, 1942 (Hartsville, S. C.), Aug. 29, 1932 (Tallulah Falls, Ga.), Aug. 10 (Flat Rock, N. C.), Oct. 6, 1921 (Dismal Swamp, Pasquotank Co. and Harnett Co., N. C.), Oct. 7, 1934 (Moore Co., N. C.), Sept. 3 (Cape Henry, Va.).

Illustrations: Britton and Brown. Illus. Flora **1**: 441.
Catesby. Natural History, Vol. **1**, pl. 15.
Safford. Ann. Rept. Smithsonian Inst., 1917, pl. 18. A good photograph including tubers.

The species occurs from central New Jersey southward in the coastal plain to the Florida Keys, along the Gulf to Texas, and up the Mississippi to Arkansas and Tennessee (Memphis). It was listed from Kentucky in Castanea (**7**: 85. 1942.), but the specimen on which the record was based turned out to be *glauca*. We have seen no published record of the occurrence of *laurifolia* in the West Indies, but it has been collected in Cuba and in the Bahamas. There are two collections of it from Cuba in the New York Botanical Garden Herbarium (No. 7273, Fre León and Fre M. Roca, south of Guines, Havana, and No. 3956, Van Herman, Batabano, Prov. de la Havana), and we have recently seen a sheet of *S. laurifolia* from Cuba, collected by Sr. J. Acuña, kindly lent us by Dr. S. C. Bruner from the herbarium of Juan T. Roig, No. 4311. Dr. Bruner has informed me that Dr. C. V. Morton of the United States National Museum has collected *laurifolia* in Cuba. In the New York Botanical Garden Herbarium are also two sheets of this species from the Bahamas (No. 703, Britton and Brace, New Providence, and No. 8858, Small and Carter, Andros.

The species *laurifolia* is a conspicuous vine of bay and swamp margins and along marshy banks of streams; common in the upper coastal plain (including the sandhills), less so in the piedmont; found by us in vigorous condition on the wooded edge of a bog about three miles from Flat Rock, N. C., far out of its recorded range. Dr. H. J. Oosting of Duke University collected it in wet woods near Hendersonville, N. C., in 1936, perhaps from the same spot (the two towns being only a few miles apart). This is what Deam might call a waif.

In *S. laurifolia*, just as in *lanceolata* (see that species), the berries are subject to attack by a grub which destroys the interior about midwinter. We have seen two cases of this from De Kalb County, Ga. (Jan. 24, 1930; Duke Herb.) and one from Hartsville, S. C. (July 3, 1942; U.N.C. Herb.). In this last case the insects had emerged, leaving a minute round hole.

In a number of our manuals the assertion is made that in *S. laurifolia* the stigma is solitary. This appears in all editions of Chapman, in all editions of Gray from 1868 to date, and in Britton and Brown. DeCandolle cites Gray's 1868 edition on this point. Whoever started this error was probably misled by examining an ovary soon after flowering. The styles, as in all our species, are quickly deciduous and the scar at the apex of the ovary might be mistaken for a stigma.

This is the most viciously armed of our species and is exceeded in stoutness only by our other handsome evergreen, *S. lanceolata*.

It should be noted that in *S. laurifolia* individual canes do not necessarily die after bearing one crop of fruit, but may live on to bear a second or even a third crop, the flowers always borne on new branchlets of the season. We have collections from a cane near Hartsville, S. C., that is bearing (Oct. 19, 1934) young fruit of the current year and at the same time old berries that are one

year and two months old. Near these are other dead branchlets, the berries and pedicels gone but the peduncles still retained, that had borne flowers in 1932. This is the case in several other species, perhaps all.

It seems to us almost certain that *S. alba* Pursh is this species. The description and habitat agree and the young berries of *laurifolia* are said to be sometimes very pale, almost whitish.

Catesby (Vol. 1, pl. 15) has a very good illustration of *S. laurifolia* (with jay bird), calling it "The Bay-Leaved Smilax." It shows ripe berries on leafless twigs and young berries on leafy twig on same branch. We think it worth while to quote his remarks in full:

> "This plant is usually found in moist places: it sends forth from its root many green stems, the branches of which overspread whatsoever stands near it, to a very considerable distance; and it frequently climbs above sixteen foot in height, growing so very thick, that in Summer it makes an impenetrable shade, and in Winter a warm shelter for cattle. The leaves are of the colour and consistence of Laurel, but in shape more like the Bay, without any visible veins, the middle rib only excepted. [There are three veins, the two lateral more obscure. W. C. C.]
>
> "The flowers are small and whitish; the fruit grows in round clusters, and is a black berry, containing one single hard seed, which is ripe in October, and is food for some sorts of birds, particularly this Jay."

We have from Wakulla, Fla. (W. W. Ashe), what appears to be a good example of the var. *bupleurifolia* Delile: leaves extremely long and narrow (e.g., 13 cm. x 4 mm., 14.5 cm. x 8 mm.). It is reported from Waccamaw River, Horry County, S. C. (Weatherby and Griscom, Rhodora **36**: 42. 1934). We also have intermediate forms from Wilmington and from Hyde County, N. C. A specimen in Duke Herbarium from Harnett County, N. C., has leaves up to 11 cm. long and only one cm. wide.

Smilax lanceolata L. Sp. Pl. **2**: 1031. 1753.
S. ovata Pursh. Fl. N. Amer. **1**: 249. 1814.
S. Smallii Morong. Bull. Torr. Bot. Club **21**: 430. 1894.
S. cinnamomifolia Small. Fl. SE. U. S., p. 282. 1903.

Plate 34 and Pl. 38, fig. 2

Underground parts without runners but composed of a thick, branched, very irregular mass of tuberous rhizomes, the large units each composed of a number of joints, up to 10, the nodes indicated only by the remains of scars of the scales, the mass reaching a length of two feet and a weight of 15.5 lbs. Canes stout and climbing very high, terete, the stronger ones up to 2 cm. thick, greenish or reddish brown, young ones and larger branches distinctly glaucous; the lower scales purplish rose; spines usually few and scattered, short (up to 3–4 mm.), flattened and often slightly recurved, rarely on very strong canes the spines may be numerous and stout and up to one cm. long, and in such cases may be set not only on the internodes but on the nodes as well and arranged in rows on each side of the petiole just as in *Bona-nox*. However, as they become fewer upward the spines disappear first from the nodes and not from the internodes, just the reverse of the case in *Bona-nox* and *glauca*. Branching in large part very regular, the alternating horizontal laterals of very even length, about 1–2 feet, at times with

only such habit the first year, again one of the laterals here and there will extend as a secondary leader, branching in the same way. Fruiting parts of canes always free of spines. Leaves evergreen, on flowering shoots usually lance-elliptic and acuminate, the margins undulate, base cuneate down to a very short petiole, blade about 1.7–3 x 5–6.6 cm., deep green and shining on upper surface, much paler and on young canes often somewhat glaucous below, with five, rarely seven, nerves; the larger leaves tending to be mottled with paler green areas; on non-flowering shoots some of the leaves at times much larger and somewhat cordate-lanceolate or even broadly ovate-apiculate; in some plants the lower or nearly all the leaves more or less hastate; margins undulate and folded upward; on the lower and central parts of the canes the margins usually set with the same little cusp-like nodules found in *rotundifolia* and *hispida* (see Pl. 34, fig. 4). Peduncles of male flowers about (3–) 5–7 mm. long, pedicels about the same or longer; peduncles of female flowers about 3–7 (–10) mm. long, pedicels about the same length. Male flowers with lobes narrowly lanceolate, recurved, spreading, up to 6 mm. long; stamens somewhat shorter. Female flowers smaller, the outer 3 lobes decidedly broader than the inner 3; stigmas prevailingly 3 by varying to 2 in the same cluster. Berries nearly globular or compressed, up to 5.5 mm. thick, usually several smaller in the same cluster, glaucous or becoming shining, dark brownish red (maroon) to blackish red or black when fully ripe; ripening in summer (June–July) about a year after flowering. Seeds usually 2, a third imperfect one often present, smaller berries as a rule with only one good seed. Flowering in June and July (June 3, 1942, and July 10, 1937, in Hartsville, S. C., late July, 1939, in Orangeburg County, S. C.). Odor very delicate and pleasing of jasmine.

Illustrations: Britton and Brown. Illus. Flora **1**: 442. 1896.
Catesby. Natural Hist. **2**: pl. 84. Berries redder than when ripe.

Occurring from southeastern Virginia and southward along the coastal plain (rarely lower piedmont) to northern Florida, Texas and Arkansas. In the New York Botanical Garden Herbarium are several sheets labelled *S. lanceolata* from Mexico, some determined by Lundell, some by E. P. Killip and C. V. Morton of the U. S. National Museum. Some look like *lanceolata*, others not enough so to be convincing.

The species is found in rich woods, banks and edges of fields and ditches in well drained but not dry soil; may occur on the margins but not actually in swamps. It is almost entirely confined to the coastal plain and more common in the lower part, but in South Carolina it follows the Pee Dee River upward through Marlboro and Chesterfield counties and into the lower margin of the piedmont in Anson County, N. C.; also found on Stone Mountain, Ga.

The canes shoot up for several to many feet without branches and with only a few leaves which are not like the adult form but are narrowly oblong and with the margins set thickly with minute pale blunt teeth. In a stong shoot in the woods at Thomasville, Ga., (Dec. 1941) there were only 6 leaves on the first 13 feet 8 inches of the shoot and these leaves were oblong and strongly hastate at base, almost as in the early ones of *S. auriculata*. The lobed base characterized all those on the main stem, and those on the side branches also showed this lobing in less and less degree, only the very ultimate ones showing no trace of it. On the slender canes of young plants the spines may be very few and small. Such

a cane from Duval County, Fla., 7 ft. 4 in. high, showed only five very small and delicate spines about 1 mm. long.

Ashe (1897) seems to have been the first to note that the berries of this species ripen the *year following* the flowers. Mohr (1901) gets it right, but Gray, Small and Rehder overlook this fact. Ashe says the berries ripen in spring, but we find them ripening in June-July in central South Carolina. Britton and Brown and Morong (in error) say they mature the first year. We find that after flowering the male branchlets lose their leaves and die, the female remain fresh until shortly before the berries are ripe a year later and then begin to lose their leaves, usually very few or none remaining after berries are ripe. In this species and in *laurifolia* the berries are subject to attack by a grub which destroys the interior about midwinter; the young parasitized berries swell up as large as when mature and become pale yellowish semi-translucent bladders with contents consisting of the grub and its castings. We have two cases showing many berries so affected—one from Dekalb Co., Ga. (Duke U. Herb. Jan. 24, 1939) and one from Marlboro County, S. C. (Univ. of N. C. Herb., July 3, 1942). In these last the insects had emerged, leaving a minute round hole.

This is the most robust of our species, reaching a greater height than *laurifolia*. Both have enormous masses of rhizomes, but we have found no example of the latter of so great weight as the *lanceolata* shown in part on Plate 38, fig. 2. However, we have no doubt that with more digging, larger ones would be found in both cases. A massive section at one end of the cluster shown on Plate 38 was broken off and not secured. This would probably have added pounds to the weight. The tubers are very shallowly placed and are more easily dug than others. When exposed and not otherwise disturbed they turn green like Irish potatoes. They are more fleshy than in other species, the newer units having about the texture of a very hard apple. The flesh is watery white, turning orange then brownish red when cut; taste mild, somewhat like an Irish potato, slightly astringent. For uses of this and other species of *Smilax*, see the Introduction.

This fine evergreen vine is the best smilax for use as an ornamental on porches and pergolas and it is so used to a considerable extent in the coastal plain of the Carolinas and Georgia and in Chapel Hill, N. C. The undergound parts are confined to the tubers, with no runners to spread the plant out of bounds, and all parts that need to be handled are free of thorns. Another advantage is the limited growth of the shoot (provided the soil is not too rich, which it seldom is around porches), which, as in other smilaxes, reaches its full height the first spring and thus does not get too heavy or difficult to control, as in so many vines. Except for the removal of dead canes, no pruning is ever necessary. This is also the species most in demand for winter decorating. In the Gulf States large quantities are gathered and shipped for the Christmas trade.

A strong plant just beyond the north end of the pergola at Mrs. C. W. Coker's at Hartsville, S. C., was cut to the ground in the winter of 1942. Last spring (1943) the tubers sent up 2 strong shoots about 18–20 feet long with several primary branches about 5–6 feet long and a good many secondary branches 1–2

ft. long, and a few short tertiary ones. The canes are now (Feb. 1, 1944) mottled gray and brown, still with a very distinct waxy coat. Very young canes of this species are distinctly green with a glaucous wax but these two have now lost most of the green. We have attached a label to these 2 shoots stating that they grew up in the spring of 1943. Returning on May 2, 1944, we find that one of these shoots had put out two, the other one, strong shoot from leafless nodes about 6–8 feet from the ground and these new shoots had reached about the length of the originals and were still growing vigorously and branching.

In summer and when not fruiting, *S. lanceolata* is distinugished from *hispida* var. *australis*, which occurs in the same regions, by the smooth margins of the upper leaves, much more lanceolate leaves, flat, not needle-like spines, and by the tuberous rhizome. From *S. laurifolia*, which may grow in the same vicinity, it is easily separated by the number of nerves of the leaves (only three in the former, five in *lanceolata*), and by its much thinner leaves.

Smilax auriculata Walt. Fl. Carol., p. 245. 1788.
S. Beyrichii Kunth. Enum. Pl. **5**: 207. 1850.
S. lata Small. Fl. SE. U. S., p. 284. 1903.
**S. maritima* Feay in Wood. Class Book of Botany, p. 702. 1861.

Plate 35 and Pl. 38, fig. 1

Underground parts composed of well defined potato-like tubers in chains and clusters or in heavier, more complicated masses, the younger ones covered with large, thin, brown-red scales which persist for years as more or less torn fragments; runners *lacking* (canes from deeply buried tubers may curve out for six or more inches before reaching the surface but these bases are not branched or permanent); underground bases of canes devoid of spines, as are the tubers, and if rooting, which is unusual, doing so only on the internodes. Tuber roots rather few, only on the internodes, long and thick with few side rootlets, much like those of *laurifolia* and *lanceolata*. For the first year tubers nearly white, both without and within but becoming pinkish when rubbed or cut, the older tubers becoming pinkish brown, the flesh bright rosy red; texture even when young very firm and tough, later hard and woody; taste bitterish. Canes usually clambering over bushes and of no great length, but at times climbing rather high (20–30 ft.), rarely over 5–8 mm. thick, the surface delicately lined throughout and roughened below with minute cusps as in *S. lanceolata* but not so harsh and at times the roughness so slight as to be hardly detectable by the finger. Spines rather numerous, short (up to 4 mm.), stout, dark, becoming much more delicate and scattered upward, usually fading out entirely, even large canes almost entirely free from spines in the upper parts, which in this species are strongly zigzag; nodes without spines and if a spine is very near a node, which is unusual, close inspection will show that it bears no relation to the petiole or stipulary line. Leaves entirely smooth (without prickles or cusps), broadly ovate to ovate-elliptic in outline, with an abrupt, firm, deflexed point, the base usually more or less pandurate or strongly auriculate and broadly rounded, thick and very prominently reticulate-veined, the primary veins five in large leaves, three in small ones, the under surface paler and often slightly glaucous, lower ones usually about 2–3.5 x 4.5–6 (8.5) cm., upper ones usually much smaller. Flowers very fragrant, few to nu-

* W. T. Feay in his Catalogue of Phaenogamous Plants, etc., includes *S. auriculata* Walt. (Oglethorpe Med. and Surg. Journ. **3**: 167-217. 1860) and does not refer to a prospective new species.

merous in a cluster, small, the male lobes 4.5 mm. long, narrow, the anthers shorter than the filaments; female flowers with lobes about 3.5 mm. long, ovary oval, the 3 styles long, slender, and broadly spreading and stigmatic along the inner surface nearly to the base. Peduncles very variable in length, the berry-bearing ones 1–10(15) mm., usually 3–8 mm. long, in fruit strongly angled but not much flattened; male 1–10 mm. long; pedicels, both male and female, about 2–7 mm. long. Berries numerous, 15–20(25+) in a cluster, varying greatly in size even in the same cluster, some round, some flattened, small ones with one, larger ones with two or three dull red seeds; berries beginning to ripen in late fall and lasting unwithered with the green leaves well into the next spring or summer; color of maturing berries purplish maroon, then purple until fully ripe, then quite black or nearly so and glaucous (usually) or shining. Blooming from mid-May to late June (July 2) on the North and South Carolina coast; April–May in Florida, sometimes as early as February in Dade County.

Illustration: Safford. Ann. Rept. Smithsonian Inst., 1917, pl. 64. Good photograph including tubers.

It occurs from Brunswick County, N. C. (Smith Island), along the Atlantic and Gulf coast to Mississippi and throughout Florida and the Keys and into the Bahama Islands. In the Carolinas, Georgia, Alabama, and Mississippi it occurs in a rather narrow strip along the coast among the dunes and in sandy flat woods. The farthest inland we have found it is at Thomasville, Georgia.

Of the seventeen sheets in the New York Botanical Garden from the Bahamas (several islands) none shows leaves truly auricled and most are merely ovate-elliptic or broadly ovate, some broadened at base. This form is also the prevailing one in southern Florida and is not rare farther north. It is what was named *S. lata* by Small. Another unusual form is represented in our herbarium from Ocean Grove, Miss. (Seymour and Earle, No. 147), and from near Del Ray, Fla. (Small et al., No. 11108). In the male clusters the peduncles are very short (0–1.5 mm.) and pedicels long (up to 1.1 cm.). All the rather large leaves are entirely without any expansion at the base.

For remarks on color of berries see Ashe (1897). Walter described the berries as purple, which is about as good as could be expected for those days. As in other species, strong canes may reach a considerable height before forming well developed leaves. In a Myrtle Beach plant, collected July 2, 1942, the first good leaf was 13½ feet from the ground.

In his Sketch of the Botany of South Carolina and Georgia, Elliott treated this species under the name *S. ovata* Pursh. Gray saw Pursh's specimens in England and positively states them to be *lanceolata* (see Morong, p. 434). Compared with certain forms of *Bona-nox*, with which in the absence of fruit or base it might be confused, *auriculata* has, fortunately, a peculiarity that will at once distinguish it—the little scale-bract that subtends a branch is not attached at the very base of the branch as it is in *Bona-nox* (Pl. 27, fig. 11) but at a distinct distance above the base, about 2.5–5 mm. (Pl. 35, fig. 4). In this particular it also differs from all our other species. In *laurifolia* and *lanceolata* this scale may at times be attached as much as 1.5 mm. above the base, but never so far up as is habitual in *auriculata*.

A difference in leaf structure that seems to be constant between *auriculata* and *Bona-nox* may be seen at the margin. When examined under a lens from

the under side, if the marginal thickening is double with a narrow groove between, at least in the upper half of the leaf, it is *auriculata*; if single with the little adjacent marginal vein approaching the marginal roll only here and there and not closely appressed to it for most of the distance, it is *Bona-nox*.

A noticeable form of this species was found growing with the typical on Merritts Island, Fla. (Jan. 29, 1936, Coker): Berries smaller, all shining black (many on typical plants still reddish and glaucous); leaves ovate-elliptic, some of the smaller ones broadest beyond the middle and very few with any tendency to lobing at the base. Ashe seems to have found the same form on the "sandy banks of Ochlochnee River, Wakulla Co., Fla.," Nov. 10, 1928, and was puzzled by it for he does not name it. His plant is like the above except that the leaves are narrower. Out of 89 leaves present on Ashe's two sheets, only seven show any lobing at the base (U. N. C. Herb.). Both of the above Florida specimens were otherwise as usual for the species,—peduncles short, leaves thick, strongly veined and abruptly mucronate, lower parts of canes minutely roughened.

Smilax havanensis Jacq. Enum. Pl. Carib., p. 33. 1760.
S. ilicifolia Desv. in Hamilt. Prodr., p. 58. 1825.
S. ilicifolia Kunth. Enum. Pl. **5**: 171. 1850.
S. coriacea Spreng. Syst. Veg. **2**: 103. 1825.
S. havanensis portoricensis A. DC. Monog. Phan. **1**: 124. 1878.
S. guianensis subarmata O. E. Schulz in Urban. Symb. Ant. **4**: 149. 1903.
S. coriacea ilicifolia O. E. Schulz in Urban. Symb. Ant. **4**: 150. 1903.
S. subarmata O. E. Schulz in Urban. Symb. Ant. **5**: 28. 1904.

Plates 20–24 and Pl. 32, figs 1–10

Evergreen; rooting parts confined to a very short, rough, blackish, irregular rootstock very much as in *pumila*, hardly a tuber; no stolons, except that short offshoots may be formed to initiate other root stocks (as in Pl. 24); habit of growth very variable: high-climbing and nearly unarmed in the hammocks, in the pinelands "stunted, rigid and with armed stems and leaves" (Small); canes greenish or brown or straw color (when dry), delicately lined and when immature thickly set with minute wax-like droplets or nodules which are connected with arachnoid filaments of apparently the same material and the wax apparently shrunken into roughish nodules arranged more or less in lines; spines short (1–1.5 mm.), stout, flattened, pale with black tips, usually recurved, a few on the nodes as well as the internodes. Leaves very variable both in size and shape (as 0.6 x 2, 1 x 4.5, 1.5 x 2.5, 1.8 x 3.5, 3.3 x 8, 13.5 x 19 cm.), narrowly oblong-elliptic to broadly elliptic to oval, the tip abruptly mucronate-spiny, or in some large ones emarginate, the base pointed, rounded, or narrowly cordate, margin with slender but strong sharp prickles or sometimes entirely smooth, rarely crinkled and thorny as in forms of holly; thick and conspicuously veiny, main nerves 5 (two additional ones sometimes visible), the larger nerves with or without spines; stomata about 33 x 37–40μ, cell walls of lower epidermis about 6–7.5μ thick; petiole 3–13 mm. long, tendrils when present near the distal end.

Flowers very small, male only about 4 mm. wide, borne as usual on slender pedicels from a swollen scaly knob on peduncles borne singly in the axils of ordinary leaves; peduncles variable in length from about 2–16 mm.; pedicels also

variable and slender, up to 6 mm. long; female flowers about 6 mm. broad when expanded, borne, in the simplest arrangement, in single clusters in axils of the leaves, but varying in all degrees from a few clusters on short, crooked, specialized branches, either with small leaves or only bracts, to forms repeatedly branched like clusters of grapes (see photograph of more complicated condition); peduncles varying from extremely short on dense clusters up to 16 mm. on simple ones; pedicels also variable, up to 6 mm.; ovary short-oval with 3 (2) styles and stigmas, aborted stamens only about ½ mm. long. Small says flowering in spring or often at other seasons. We note in herbaria, flowers in March (Porto Rico) and in July (Cuba). Small gives the color of the berry as jet black; others have called them red and purple. We find them to be small, purplish to black, 1–3-seeded the seeds red-brown, 3–3.5 mm. in diameter. The sequence of colors in ripening is probably the same as in *auriculata*.

Illustrations: Jacquin. Sel. Stirp. Amer. Hist., pl. 179, fig. 102. 1763. Also his Amer. Picta, pl. 263, fig. 83. 1780.

Southern Florida and the Keys, Bahamas, Cuba, Porto Rico, Virgin Islands, Dutch West Indies (St. Martin). DeCandolle reports it also from Mexico but Standley (1920) thinks this may be an error.

Through the great kindness of Dr. S. C. Bruner and Sr. Julián Acuña of Cuba we have recently received plants of *havanensis* showing underground parts. It is from one of these that we describe and illustrate these parts, apparently for the first time.

Smilax pumila Walt. Fl. Carol., p. 244. 1788.
S. pubera Michx. Fl. Bor. Amer. **2**: 238. 1803.
S. puberula Kunth. Enum. Pl. **5**: 193. 1850.

Plates 25 and 36

Underground part a small, knotted, woody, nearly black rootstock up to 5 or 6 cm. long and 2 cm. thick, from which radiate a large number of stout roots up to 2 feet long and one to several slender, glabrous, white or pinkish runners up to 1.5–4 mm. thick with very delicate and rather short, much branched roots borne on the internodes and now and then much stouter and longer roots on the nodes, occasional new runners arising from joints of older ones and such joints becoming smaller, secondary root-stocks. Aerial shoots terminating runners and up to 1½–3 feet long, weak, slender, prostrate or clambering with a few delicate tendrils, densely woolly-pubescent; fruiting branches renewed yearly from buds nearer the base. (The stems near the base are often covered, and at times the petioles, with a dark brown fungus which appears to be a species of *Coniophora*.) Leaves more or less evergreen, depending on climate, the blade up to 8 cm. broad and 10.5 cm. long, obovate to ovate-lanceolate, notched or strongly and broadly cordate at base, the tips bluntly pointed; main nerves 3, with 2 shorter marginal ones that are more or less well-defined; unfolding leaves densely woolly all over, mature ones with upper surface deep green, shining and sparsely hairy or nearly glabrous, but scurfy over the depressed veins, lower surface densely soft whitish or pale brownish pubescent, the veins very prominent and reddish in color; petioles 0.5–2 (−2.5) cm., rarely up to 8.5 cm. long on short sterile shoots, rather stout, often crooked, densely pubescent; stipular wings lacking, represented only by the clasping base which begins to expand only one or two mm. above the node;

tendrils arising from the terete petiole about 2–3 (–5) mm. from the base. Flowers numerous, peduncles usually shorter than the petioles, about 2–8 (–15) mm. long, densely woolly as is the swollen receptacle at its end, pedicels 1–2 mm. long, glabrous; male flowers with recurved lanceolate lobes about 4–5 mm. long, anthers much shorter than the filaments; female flowers smaller, the lobes about 3 mm. long, the one-celled and one-ovuled ovary tapering into the short style capped by a slanting, 2-lobed stigma; anthers when mature and when just opened, straight, soon curving backward; pollen grains spherical, smooth or nearly so, 20–28μ in diameter. Berries oval to ovate, abruptly pointed, variable in size, 7–10 mm. long, bright orange to orange red, glabrous and shining; seed one, oval, light orange with a black basal disk. Flowering in October or early November at Brookgreen Gardens (Georgetown Co.), S. C.; just beginning to bloom there on Sept. 25, 1943. Minute buds about one mm. in diameter begin to appear about the end of June on the South Carolina coast. Berries ripening in the fall of the next year.

Illustration: Catesby. Natural History **1**: pl. 47. 1731.

Sandy soil in woods, coastal region from Myrtle Beach (Horry Co.), South Carolina, and central Florida (Lake Co.) to Texas, occurring inland as far as 28 miles north of Charleston (Cypress Gardens), S. C.; Americus (Sumter Co.), Ga.; Brewton (Escambia Co.), and Sealy Springs (Houston Co.), Ala. We have it also from Auburn (Lee Co.), Ala. (Harbison, coll.), a remarkable inland extension of its range. Mohr also records it from the vicinity of Auburn and says this is its inland limit ((pp. 65, 66, 446). This is above the coastal plain on the southern edge of the metamorphic hills, altitude 850–900 ft.

Walter described the berries as whitish, and even though corrected by Nuttall (1818), this error is repeated by Elliott, Pursh, and even by Chapman in his first and second editions. In his third edition Chapman omits mention of color.

Michaux (1803), while admitting that Walter's *pumila* might be the same, proposes his own specific name *pubera* on account of the poor description of the former. However his own description is quite inadequate, saying of the fruit only that it is one-seeded by abortion. As the ripe berries, being very persistent, can easily be found at any time of the year, it is very strange that among moderns they were never correctly and adequately described until by Morong (1894). All of these gentlemen were evidently unaware that in 1731, 57 years before Walter's Flora Caroliniana, Catesby had illustrated (see above) and described what we now call *S. pumila* in a wholly convincing way (as usual of course with some incorrect details). The shape of the leaves is about right and the berries are almost perfect in both color and shape (a little too sharply pointed). The peduncles and pedicels are too long and the leaf venation is conventional. Catesby says: "This Plant sometimes trails on the ground. The leaves resemble those of the *Birth-wort*, and are set alternately on its tender stalks; from which hang clusters of small red berries of an oval form, but pointed, each containing a very hard round seed." The habit of maturing the second year, as well as the pointed berry, was noted by Elliott (1824) and then overlooked by all authors until Sterns (1888a) observed it independently, not mentioning the work of

Elliott. Subject to the same fate that seemed to follow all those who wrote on the subject, Elliott says the time of ripening is March, whereas the berries really ripen in the fall.

The hairs of *pumila* are worthy of a further note. They are about 0.5–0.9 mm. long, never straight but curled and contorted to form a woolly blanket. The main length is a single empty cell with rather thick walls that arises from a base of three peculiar cells (Pl. 36, figs. 10, 11).

Smilax pumila is such an odd little plant that it easily could be the type species of a separate genus. It differs from all other members of the genus in the United States in several important respects: the dwarf stature, woolly covering of almost the entire plant, the absence of prickles, and above all in the bottle-shaped pistil of a single carpel with no demarcation between ovary and style at the time of anthesis (Pl. 36, fig. 7). All others have an oval or nearly spherical pistil with three (rarely two) very distinct styles. In all cases the styles wither and fall off very soon after flowering. The little berry is of a different shape from any other and in its brilliant red color is matched only by *Walteri*. Very rarely *Walteri* may have an abruptly pointed berry, but even then the shape is not the same.

In Central America and Mexico there are a number of softly pubescent and spineless species, of which *S. mollis* is a typical example, that obviously form a transition group between *pumila* and the spiny non-tomentose species. Their leaves also are strikingly like those of *pumila* and most of them at least seem to have red or reddish berries. All however have three styles and three or two (rarely one) seed, and are stout climbers. Their kinship to *pumila* is still further shown by the striking similarity of the structure of the hairs, at least in *mollis*, a single long cell forming the hair proper, with the base composed of several short stout cells.

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EXPLANATION OF PLATES

PLATE 9

Smilax glauca. Highlands, N. C., Aug. 2, 1942. Showing four consecutive parts of one cane, beginning at A, two inches above the ground. × ⅔.

PLATE 10

Smilax laurifolia (above). Fresh green berries, Berkeley Co., S. C., Jan. 6, 1943. × ⅔.
Smilax Bona-nox (below). Photomicrographs of scurf on two stems. Chapel Hill, N. C., Jan. 1943.

PLATE 11

Smilax Bona-nox var. littoralis n. var. Type plant. Tuber with roots and runners. × ⅓.

PLATE 12

Smilax rotundifolia. Highlands, N. C., Sept. 7, 1943. Section of rhizome, ventral side. Nat. size.

PLATE 13

Smilax hispida var. australis. (Left) Cultivated in Mason Farm shrub garden, University of North Carolina, brought from Thomasville, Ga. Male flowers. × ⅔. (Right) Darlington, S. C., Sept. 16, 1936. Showing fibrous roots and absence of underground runners. × ⅓.

PLATE 14

Smilax hispida var. montana n. var. Mt. Satulah, Highlands, N. C., Aug. 19, 1943. A young plant showing a runner with two aerial shoots. × $\frac{3}{10}$.

PLATE 15

Smilax hispida var. montana n. var. Mt. Satulah, Highlands, N. C., Aug. 27, 1943. × ⅔. Note: The upper line of the apparently double runner is a shadow.

PLATE 16

Smilax hispida var. montana n. var. Shortoff Mt., Macon Co., N. C., July 17, 1939. Showing part of a long, underground runner. × ⅔.

PLATE 17

Smilax californica. Del Norte Co., California (from Dudley Herb., Stanford University). × ⅔.

PLATE 18

Smilax californica. Siskiyou County, California (from Dudley Herb., Stanford University). × ⅔.

PLATE 19

Smilax laurifolia. Bladen County, N. C., March 24, 1942. Ripe berries. × ½.

PLATE 20

Smilax havanensis. Province of Havana, Cuba. Male flowers. × ⅔.

PLATE 21

Smilax havanensis. (Above) Monte Torrecilla, Porto Rico (N. Y. B. G. Herb., No. 5604, as *S. coriacea*). Female flowers. (Below) Valley of Rio de Maricao, Porto Rico (N. Y. B. G. Herb., No. 4186 as *S. coriacea*). Large leaves with prickles. Both × ⅔.

PLATE 22

Smilax havanensis. Porto Rico. Large leaves without prickles. × ⅔.

PLATE 23

Smilax havanensis. Porto Rico (N. Y. B. G. Herb., No. 157, as *S. coriacea*). × ⅔.

PLATE 24

Smilax havanensis. Camagüey, Cuba, about May 1, 1944. Rhizome with bases of aerial shoots. Nat. size.

PLATE 25

Smilax pumila. (Left) Thomasville, Ga., Dec. 30, 1941. Young plant. Note long petioles, peculiar to young vigorous shoots. × ½. (Right) About six miles north of Charleston, S. C., Jan. 6, 1943. Underground parts with bases of two aerial shoots. × ½.

PLATE 26

Smilax glauca

Fig. 1. Twig showing habit of leaves and berries. × ½. Hartsville, S. C., Nov. 24, 1934. Berries black with a bloom, 2-seeded.
Fig. 2. Base of leaf showing petiole with flanges and tendrils. × 2. Chapel Hill, N. C.
Fig. 3. Twig with cluster of female flowers. × ½. Chapel Hill, May 22, 1943.
Fig. 4. Cluster of female flowers. × ½. Hartsville, S. C., May 22, 1909.
Fig. 5. Single female flower from same cluster. × 2.
Fig. 6. Style and stigma from above. × 12.
Fig. 7. Cluster of male flowers. × ½. Near Jacksonville, Fla., 188-(?), A. H. Curtis, coll.
Figs. 8–10. Variations in leaf shape, × ½. Plants from Chapel Hill, N. C., Hartsville and Charleston, S. C., respectively. See plate 9 for other leaf forms.
Fig. 11. Thorny node. × ½. Hartsville, S. C., April 11, 1942.
Fig. 12. Young plant. × ½. Lunz place, Charleston, S. C., April 22, 1943.
Fig. 13. One-year seedling. × ½. Highlands, N. C., July 14, 1942.
Fig. 14. Short, unicellular papillae on under side of leaves, shown in surface view. × 185. Americus, Ga., March 22, 1944.
Fig. 15. Same in side view.

PLATE 27

Smilax Bona-nox

Fig. 1. Twig with cluster of female flowers. × ½. Chapel Hill, May 14, 1943.
Fig. 2. Twig with cluster of male flowers. × ½. On dry ridge near Chapel Hill, May 6, 1935.
Fig. 3. Female flower from cluster in fig. 1. × 2.
Fig. 4. Cluster of young berries showing oblong shape at that stage (berries about 2.7 x 4.5 mm.). × ½. Chapel Hill, July 5, 1942.
Fig. 5. Mature berry of pointed form. × 2. Chapel Hill, Jan. 19, 1935.
Fig. 6. Twig with cluster of berries, as above, from same collection. × ½.
Fig. 7. Mature berry of bluntly rounded type. × 2. Chapel Hill, middle of Jan. 1935.
Fig. 8. Habit of leaves and berries. × ½. Chapel Hill, Nov. 18, 1934. Berries jet black, shining, ovate, 1-seeded.
Fig. 9. Epidermal cells from cane about 2.5 mm. thick. × 335. The cortical cells for about 5 cells deep are green and these green cells and the parenchyma farther inward contain starch in quantity. Plant from Coker Arboretum, Chapel Hill, March 29, 1943.

Fig. 10. Stomata from lower surface of leaf. × 335. Same plant as above.
Fig. 11. Sketch showing plant about 8–10 years old, with tubers and two kinds of roots, large ones coming from tubers, and much more delicate thread-like ones from underground nodes of the uprights. × ⅓. Chapel Hill, Feb. 18, 1935. Note that most of the roots have shed their soft cortex, while some are still shedding.
Fig. 12. Section of main stem not far from base, set with fascicles of short, spreading, pale, later brown, scale-like hairs. × ½. Near Darlington, S. C., Dec. 9, 1934. See also plate 10.
Fig. 13. Section of a glabrous cane showing spines on node and internodes (leaf represented by leaf sheath). × ½. Chapel Hill, March 12, 1942.
Fig. 14. Sketch of seedling (3–4 years old). × ½. Under pines, Chapel Hill, Sept. 10, 1936.

PLATE 28

Smilax Bona-nox var. *littoralis*

Fig. 1. Habit sketch showing smaller leaves and berries. × ⅓. Plant from Col. Springs's place near Myrtle Beach, S. C., Dec. 8, 1934, B. E. Smith, coll.
Fig. 2. As above, Feb. 27, 1943.
Fig. 3. Larger leaf. × ½. Myrtle Beach, S. C., July 2, 1942.
Fig. 4. Narrow hastate leaf. × ½. Myrtle Beach, Feb. 27, 1943.
Fig. 5. Blotched leaf. × ½. Michaux's Garden, S. C., June 8, 1910.
Fig. 6. Cluster of young berries. × ½. Type plant, sandy flat, Myrtle Beach, S. C., July 2, 1942.
Fig. 7. Year-old, ripe berries from type plant. × ½. July 2, 1942. Peduncle flat and wide.
Fig. 8. Twig with clusters of female flowers. × ½. Ocean Drive Beach, 17 miles north of Myrtle Beach, May 11, 1941.
Fig. 9. Same leaf as in fig. 10 but flattened out to show shape. × ½.
Fig. 10. Twig with leaf and cluster of male flowers. × 2. Same data as for fig. 8.
Fig. 11. One-year seedling. × ½. Charleston, S. C., April 22, 1943, G. R. Lunz, coll.
Fig. 12. Base of 2-year seedling. × 2. Same data as above.

PLATE 29

Smilax rotundifolia

Fig. 1. Twig with cluster of female flowers. × ½. Chapel Hill, April 29, 1935.
Fig. 2. Twig with clusters of male flowers. × ½. Data as above.
Fig. 3. Leaf base showing densely papillate leaf flanges. × 4. Jennings Co., Ind., July 5, 1941.
Fig. 4. Male flower. × 2. Data as for fig. 1.
Fig. 5. Rare bisexual flower. × 2. Chapel Hill, May 8, 1943. These anthers bore pollen.
Fig. 6. Stamen and perianth lobe from same. × 3.
Fig. 7. Female flower with 4 styles and stigmas. × 2. Data as above.
Fig. 8. Female flower with 2 styles and stigmas. × 2. Chapel Hill, May 13, 1943.
Fig. 9. Typical female flower with 3 styles and stigmas. × 2. Same data as for fig. 8.
Fig. 10. Twig with berries. × ½. Wilkes Co., N. C., Aug. 31, 1936.
Fig. 11. Seedling. × ½. Highlands, N. C., July 14, 1942.
Fig. 12. Section of stem. × ½. Hartsville, S. C., Nov. 24, 1934, B. E. Smith, coll.
Fig. 13. Twig with leaf and berries. × ½. Same data as for fig. 12.
Fig. 14. "Tooth" from under side of vein of leaf. × 185. Jennings Co., Ind., July 5, 1941

PLATE 30

Smilax Walteri

Fig. 1. Twig with leaves and cluster of female flowers. × ½. Plant originally from Chatham Co., N. C., now in Mason Farm shrub garden, Chapel Hill, May 17, 1942.

Fig. 2. Female flower. × 2. Same place, May 13, 1943.
Fig. 3. Berries of the pointed type. × ½. From neighborhood of Hartsville, S. C.
Fig. 4. Berries of obovate shape. × ½. Hartsville, S. C., Oct. 18, 1939.
Fig. 5. Twig with cluster of male flowers. × ½. Near Linden, N. C., April 13, 1921, J. S. Holmes, coll.
Fig. 6. Abnormal flowers from same plant as above. × 1½. The upper two are fused at base of pedicels and have 6 perianth parts but 8 stamens each. The lower one is normal in number of parts.
Fig. 7. Part of branch showing habit, leaves, and berries of different shapes. × ½. Near Hartsville, S. C., Oct. 19, 1934.
Fig. 8. Stomata. × 185. The lower 4 are from the *upper* epidermis, the other from the lower. Plant from Pender Co., N. C., Oct. 19, 1940.

PLATE 31

Smilax hispida, Figs. 1–6

Fig. 1. Twig with cluster of female flowers. × ½. Back of Mason Farm house, Chapel Hill, May 21, 1943.
Fig. 2. Female flowers with 3 and 4 styles and stigmas. × 2. Same data as above.
Fig. 3. Twig with cluster of male flowers. × ½. Same place as above, May 16, 1943.
Fig. 4. Adaxial view of a petiole, showing a very young cluster of male flowers. × 2½. Same place as above, May 15, 1943.
Fig. 5. Stomata on lower surface of leaf (none found on upper). × 185. Same place as above, June 16, 1942.
Fig. 6. Abnormal stomata on tendril. × 335. Same place as above, April 15, 1943.

Smilax hispida var. *australis*, Figs. 7–12

Fig. 7. Twigs and leaves. × ½. Near Jacksonville, Fla., April 13, 1893, A. H. Curtis, coll. These are small leaves from near base of a branch.
Fig. 8. Twig with fruit. × ½. Darlington, S. C., Dec. 9, 1934, Norton, Smith, and Matthews, colls.
Fig. 9. Twig with cluster of female flowers. × ½. Near Jacksonville, Fla., April 10, 1894, A. H. Curtis, coll.
Fig. 10. Female flower. × 2. Same data as above.
Fig. 11. Twig with cluster of male flowers. × ½. Thomasville, Ga. (now in Mason Farm shrub garden), May 23, 1943.
Fig. 12. Twig with leaves. × ½. Darlington, S. C., Dec. 9, 1934, Norton, Smith, and Matthews, colls.

Smilax hispida var. *montana*

Fig. 13. Twig with leaves and fruit. × ½. Shortoff Mt., Highlands, N. C., Sept. 5, 1939. Most of these berries are unusually large and the largest contain 3 seeds.

PLATE 32

Smilax havanensis, Figs. 1–10

Figs. 1–5. Twigs with leaves showing great variation in size and shape. All × ½. Fig. 1. Plant from Cuba (Herb. Estacion Central Agron.; Shafer, coll., April 1903). Fig. 2. Bordeaux, San Juan, West Indies, Feb. 10–12, 1913 (N.Y.B.G.; Britton and Shafer). Fig. 3. Between Miami and Cocoanut Grove, Fla., Nov. 26–Dec. 20, 1913 (Duke U. Herb.; J. K. and G. K. Small). Fig. 4. Key Largo, Monroe Co., Fla., Dec. 27, 1940. Fig. 5. Rio de Maricao Valley, Porto Rico, Feb. 14, 1915 (N.Y.B.G.; Britton and Cowell).
Fig. 6. Twig with cluster of male flowers. × ½. Near Managua, Cuba, July 19, 1904 (Herb. Estacion Central Agron.; Baker and Wilson).

Fig. 7. Male flower from same cluster. × 2.
Fig. 8. Female flower. × 2. Mont Torrecilla, Porto Rico, Mar. 19–20, 1915 (N.Y.B.G.; Britton, Cowell, and Brown).
Fig. 9. Twig with leaves and fruit. × ½. Between Miami and Cocoanut Grove, Fla. Nov. 26–Dec. 20, 1913 (Duke U. Herb.; J. K. and G. K. Small).
Fig. 10. Twig with leaves and fruit. × ½. Big Pine Key, Fla., Nov. 17, 1912.

Smilax californica, Figs. 11–16

Fig. 11. Twig with leaf and cluster of male flowers. × ½. Shasta Co., Cal., May 25, 1940 (N.Y.B.G., No. 6595; C. L. Hitchcock).
Fig. 12. Another cluster, as above, showing odd arrangement of pedicels.
Fig. 13. Twig with cluster of female flowers. × ½. Near Dana, Shasta Co., Cal., June 1903 (N.Y.B.G., No. 4170; Hall and Babcock).
Figs. 14 and 15. Female flowers from same cluster, one with two pistils. × 2.
Fig. 16. Twig with fruit not yet mature. × ½. Note one branched pedicel (2 berries). Klamath River Gorge, Siskiyou Co., June 20, 1940 (N.Y.B.G., No. 15158; W. B. Cooke).

PLATE 33

Smilax laurifolia

Fig. 1. Habit sketch. × ½. Swamp near Hartsville, S. C., Oct. 19, 1934, Velma Matthews, coll.
Fig. 2. Large leaf from same collection. × ½.
Fig. 3. Stomata on under surface of leaf. × 335. Mason Farm, Chapel Hill, April 25, 1943. Globules in guard cells are oil.
Fig. 4. Section of stem. × ½. Swamp near Hartsville, S. C., Nov. 24, 1934, B. E. Smith coll.
Fig. 5. Clusters of male flowers. × ½. Hartsville, S. C., Sept. 2, 1942, Velma Matthews, coll.
Fig. 6. Unusual female flower with 4 stigmas. × 2. Tallulah Falls, Rabun Co., Ga. Aug. 29, 1932.
Fig. 7. Female flowers, one showing the usual 3 stigmas and one with 2. × 2. Hyde Co., N. C., April 1898, W. W. Ashe, coll. All female flowers show the filaments of sterile stamens.
Fig. 8. Sketch of seedling with small tuber and bud. × ½.
Fig. 9. Base of same. × 2.
Fig. 10. Twig with leaves and flower buds. × ½. Peninsula of Zapota, Province of Santa Clara, Cuba, May 7–11, 1927 (Herb. of Juan T. Roig; J. Acuña, coll.).

PLATE 34

Smilax lanceolata

Fig. 1. Plant about 6 or 7 years old. × ½. Col. Kolb's Tomb near Society Hill, S. C., March 19, 1935.
Fig. 2. Stoma from tendril. × 335. Vine cultivated in Chapel Hill, May 11, 1944. About half the contents shown in guard cells are oil (dotted) and half starch.
Fig. 3. Stomata on lower epidermis of fresh green leaf. × 335. Chapel Hill, March 31, 1943.
Fig. 4. Margin of leaf showing nodular cusps. × 2½. Cultivated on Mason Farm, originally from South Carolina, Jan. 1, 1941.
Fig. 5. Twig with cluster of female flowers. × ½. Cultivated in Hartsville, S. C., July 10, 1937.
Fig. 6. Female flower of same. × 2.
Fig. 7. Twig with cluster of male flowers. × ½. Same data as above.

Fig. 8. Male flower. × 2. Same data as above.
Fig. 9. Twig with leaves and young green fruit. × ½. Near Darlington, S. C., Dec. 9, 1934, Norton, Matthews, Smith, colls. Note folded up margins of leaves.
Fig. 10. Twig with fruit. × ½. Cultivated at Hartsville, S. C., July 10, 1937. These berries are one year old and the leaves have all dropped from the old part of the plant. The same plant was blooming on this date.
Fig. 11. Tip of shoot with well developed tendrils but aborted leaf blades. Cultivated in Chapel Hill, May 11, 1944.

PLATE 35

Smilax auriculata

Fig. 1. Sketch showing leaves and fruits. × ½. Sand dunes, Myrtle Beach, S. C., Dec. 8, 1934. Berries strongly glaucous, many distinctly red at this date, others nearly black but with reddish tint.
Fig. 2. Twig with leaves. × ½. Myrtle Beach, S. C., Sept. 12, 1936.
Fig. 3. Twig with leaf. × ½. St. Helena Island, S. C., Nov. 28, 1936.
Fig. 4. Node showing base of lateral branch with bud scale about 2.5 mm. above the base of the branch. × 1. Southwest of Avon Park, Fla., Nov. 10, 1928, W. W. Ashe, coll.
Fig. 5. Stomata from lower epidermis of leaf. × 335. Charleston, S. C., Jan. 5, 1943.
Fig. 6. Lower part of stem and part of rhizome, showing roots all internodal. × ½. Near Thomasville, Ga., Dec. 30, 1941.
Fig. 7. Cluster of male flowers. × ½. Brookgreen Gardens, Georgetown Co., S. C., June 3, 1943, F. G. Tarbox, coll. Flowers varying from 8 to 20 in a cluster.
Fig. 8. Cluster of female flowers. × ½. Same data as above. One flower had 9 perianth lobes.
Fig. 9. Female flower, showing 3 stigmas and abortive stamens. × 2. Myrtle Beach, S. C., June 9, 1943.

PLATE 36

Smilax pumila

Fig. 1. Habit sketch. × ½. Cypress Gardens, S. C. (native), Jan. 3, 1935.
Fig. 2. Base of a leaf. × 2. As above, March 16, 1940.
Fig. 3. Cluster of male flowers. × ½. Brookgreen Gardens, Georgetown County, S. C., Sept. 30, 1943, F. G. Tarbox, coll.
Fig. 4. Male flower from same cluster. × 2.
Fig. 5. Twig with cluster of female flowers. × ½. Brookgreen Gardens, Oct. 31, 1937, F. G. Tarbox, coll.
Fig. 6. Cluster of female flowers. × 2½. Same data as above.
Fig. 7. Female flower and separate pistil. × 2 and × 4, respectively. Same data as above.
Fig. 8. Twig with clusters of young berries. × ½. St. Helena Island, S. C., Nov. 28, 1936.
Fig. 9. Mature berries. × ½. Cypress Gardens, S. C., Dec. 1, 1936.
Fig. 10. Base of a hair from near bottom of stem, with an epidermal cell attached. × 335. Brookgreen Gardens, Oct. 27, 1937.
Fig. 11. Hair from under surface of leaf. × 80. Thomasville, Ga., Dec. 30, 1941.
Fig. 12. Base of hair from under surface of leaf, with several epidermal cells attached. × 185. Data as above.
Fig. 13. Horizontal underground runner. × ½. St. Helena Island, S. C., Nov. 28, 1936.
Fig. 14. Bit of an unusually stout underground runner. × ½. Americus, Ga., March 22, 1944, Paul Tabor, coll.

PLATE 37

Fig. 1. Cross section of fruit of *Smilax laurifolia*. × 9. Near Hartsville, S. C., Jan. 29, 1944. Fruit 3-celled but one-seeded (J. E. Adams, del.).
Fig. 2. As above, but fruit 2-celled and one-seeded.
Fig. 3. As above, but fruit 3-celled and 2-seeded.
Fig. 4. Tubers and runners of *Smilax glauca*. × ½. Chapel Hill, March 6, 1935.
Fig. 5. Tubers and runners of *S. glauca*. × ½. Americus, Ga., March 22, 1944.

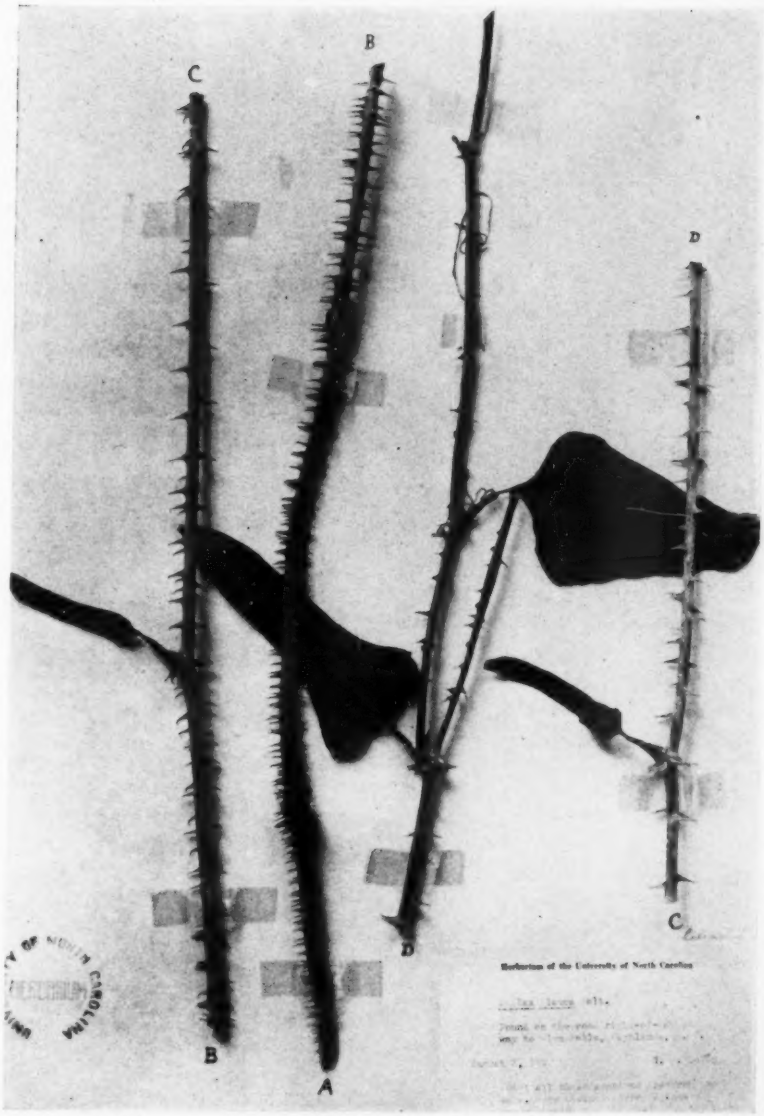
PLATE 38

Fig. 1. Tubers and runners of *Smilax auriculata*. × ½. Myrtle Beach, S. C., Sept. 12, 1936.
Fig. 2. Tubers and runners of *S. lanceolata*. × ½. Darlington, S. C., Sept. 16, 1936.
Fig. 3. Runner (stolon) of *S. Walteri* with one aerial branch (horizontal on plate). × ½. Chatham Co., N. C., Nov. 26, 1937. Roots only at nodes; no tubers.

PLATE 39

Tubers of *S. Bona-nox*, densely covered with spines, and bases of aerial shoots. Note rooting only at the nodes. × ½. Darlington, S. C., Dec. 9, 1934.

PLATE 9



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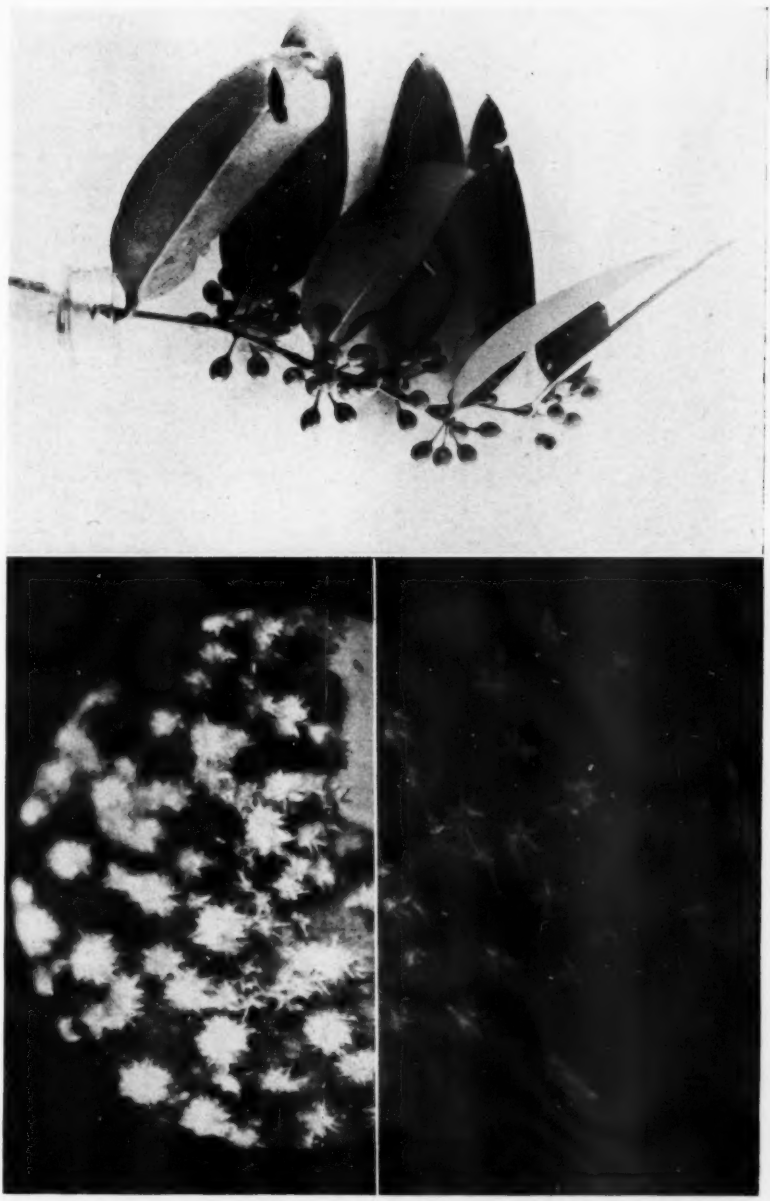

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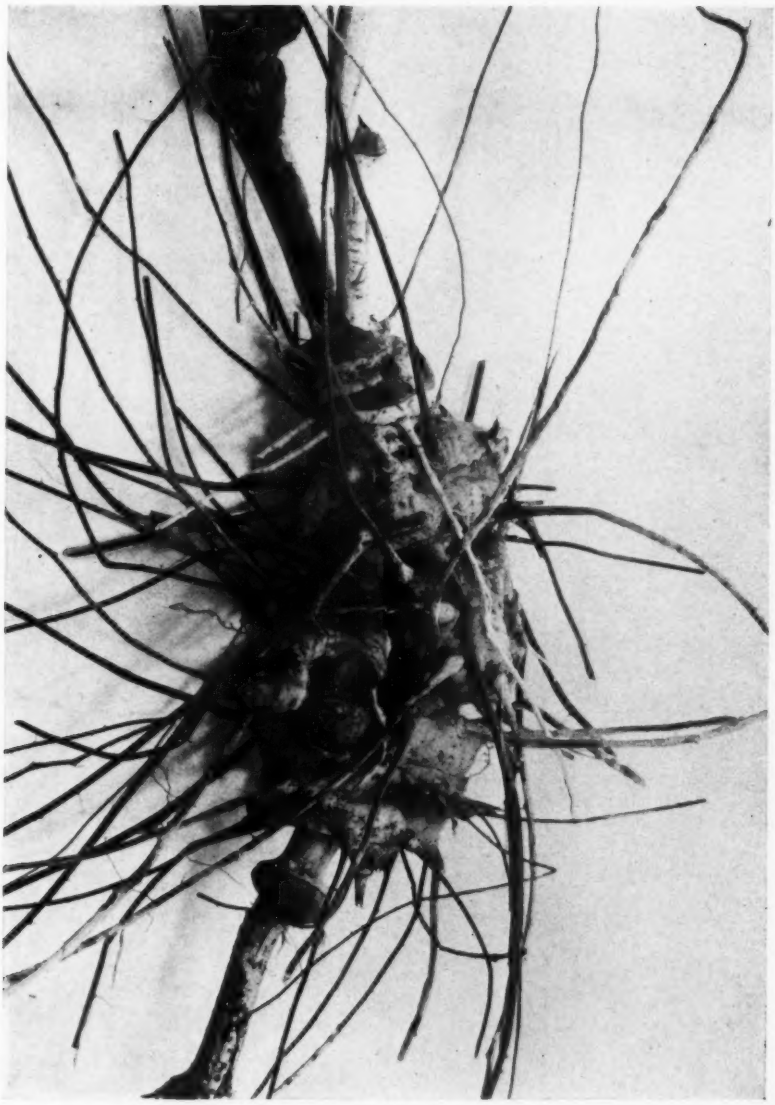

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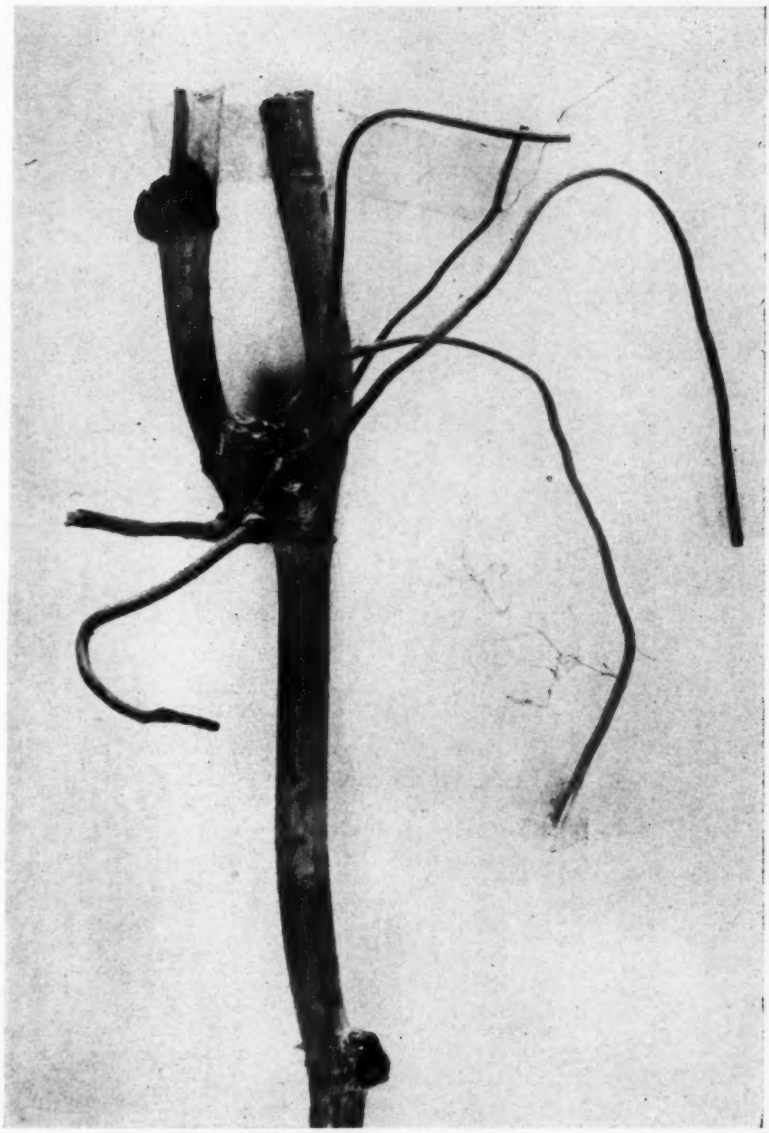

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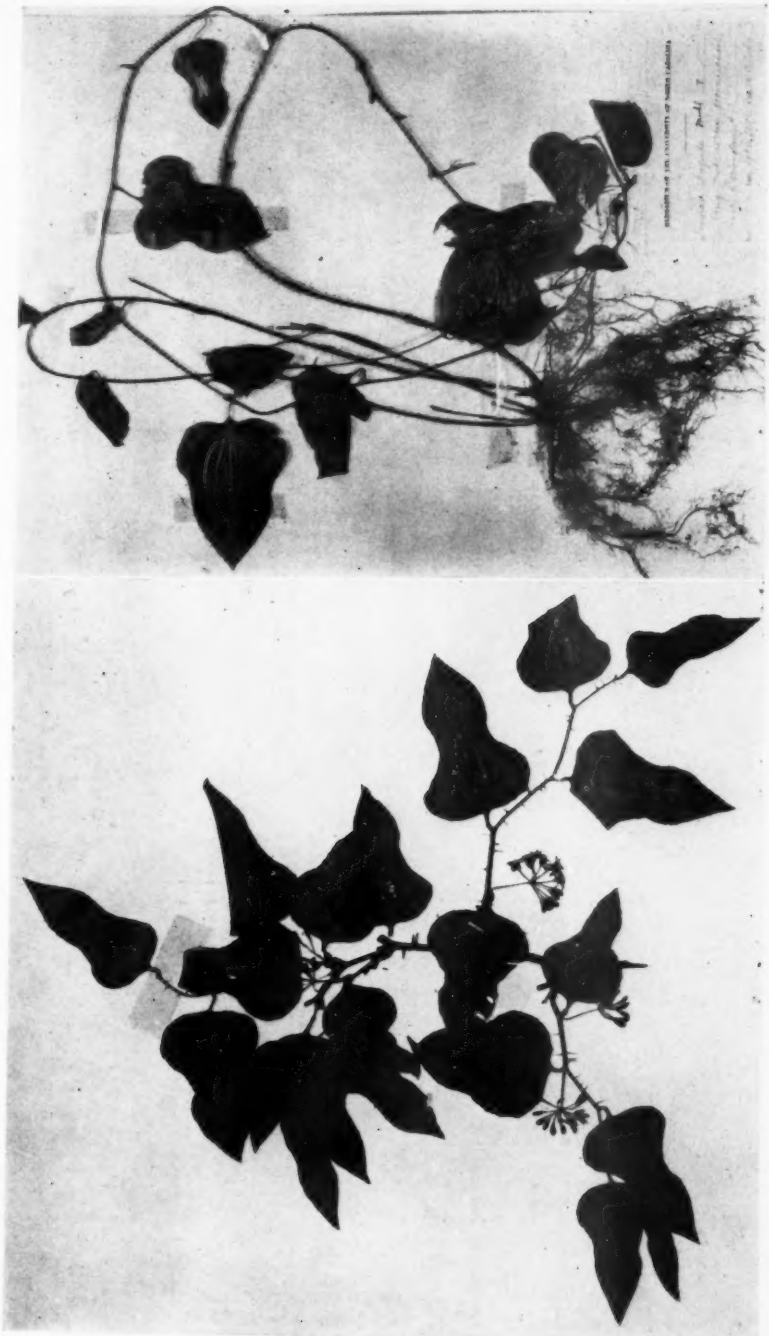

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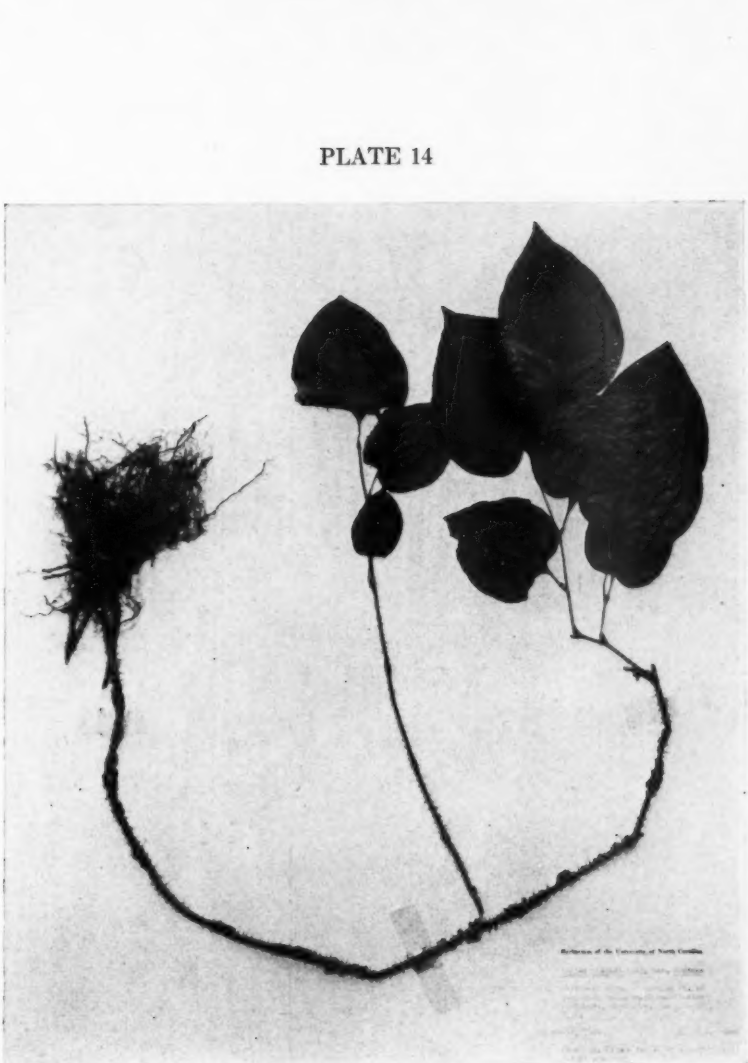

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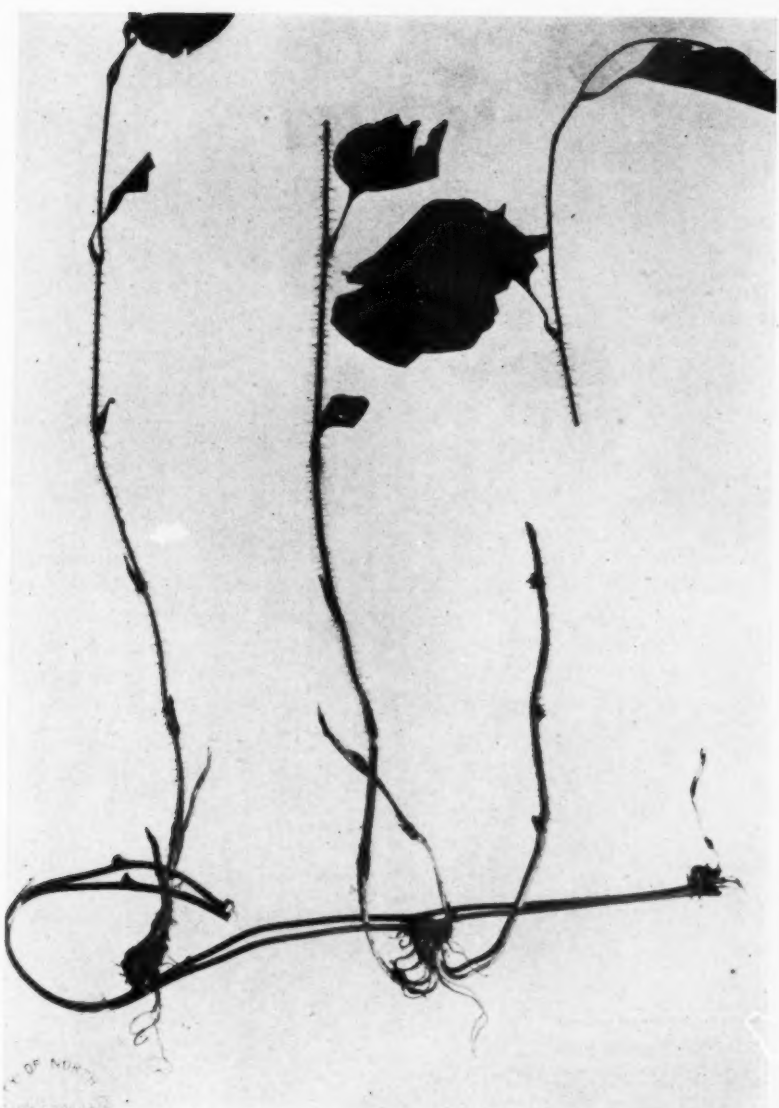

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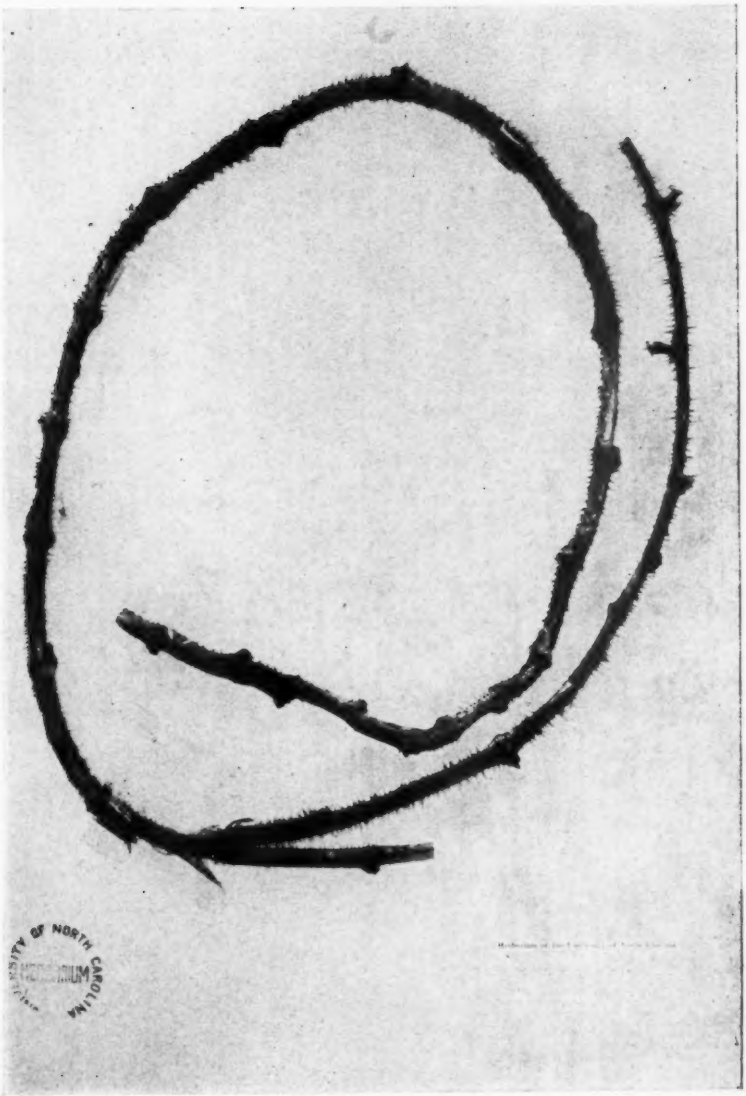

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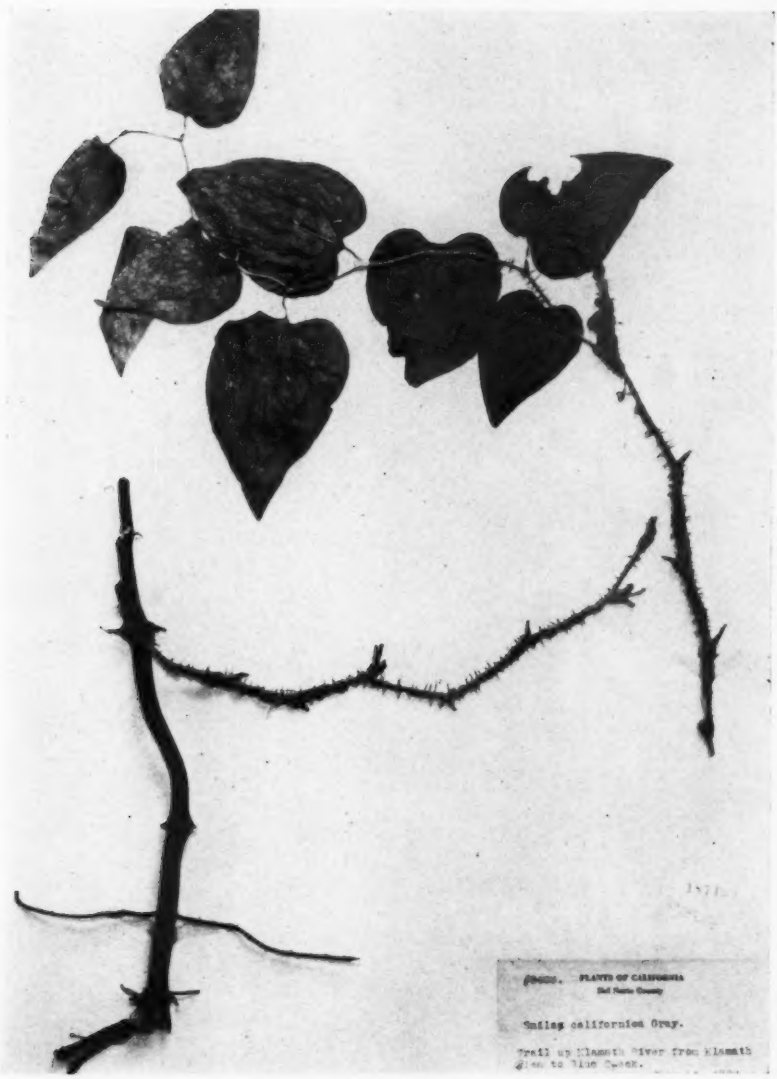

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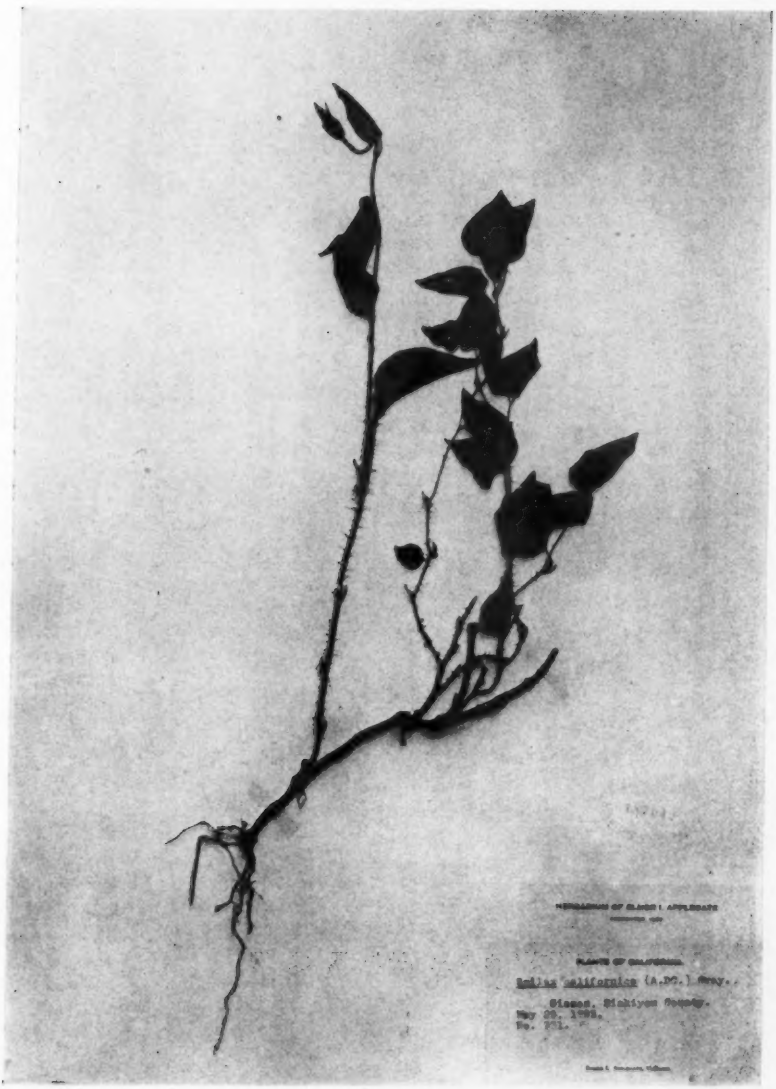

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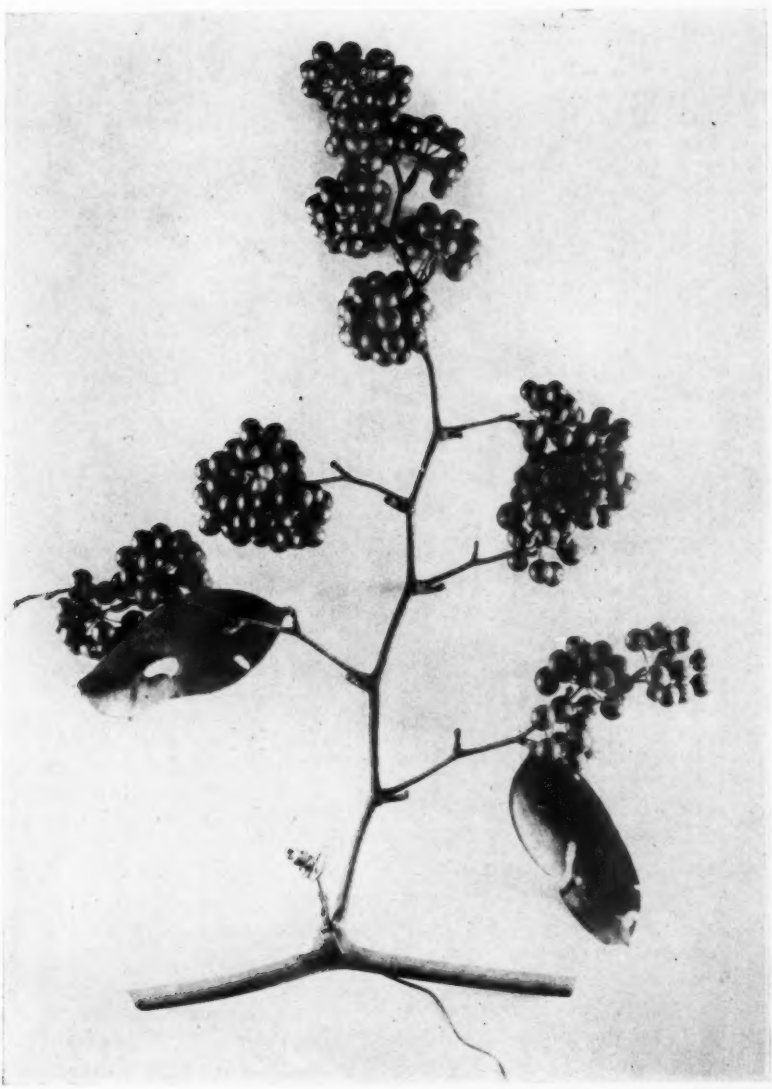

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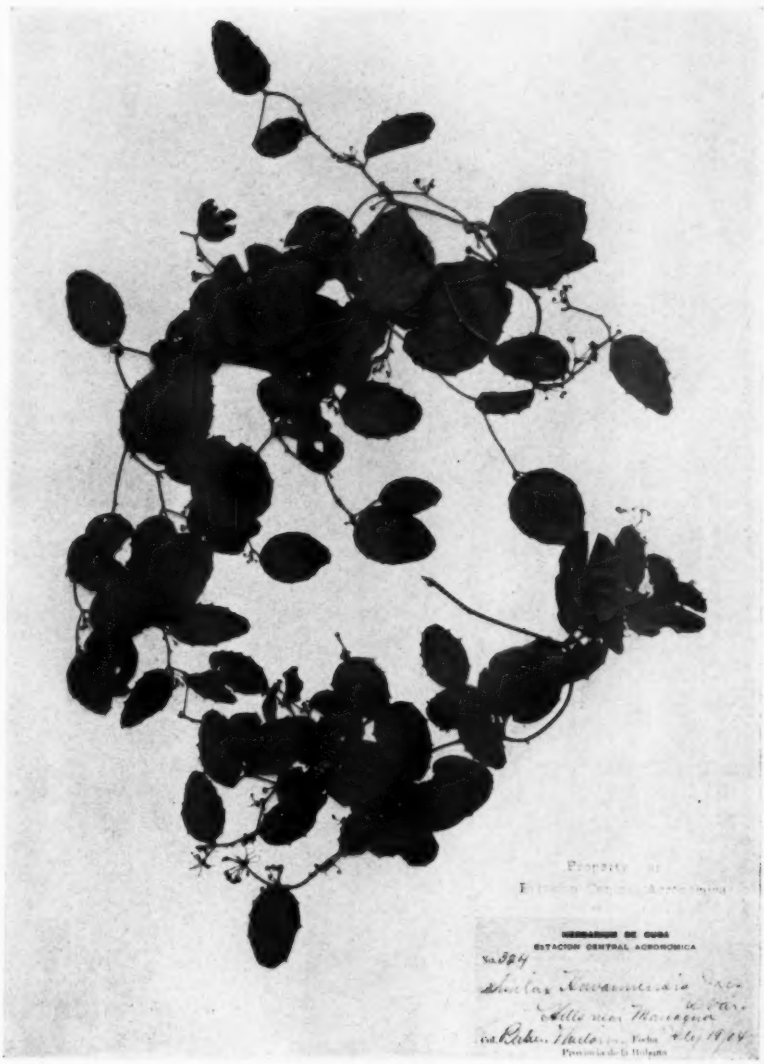

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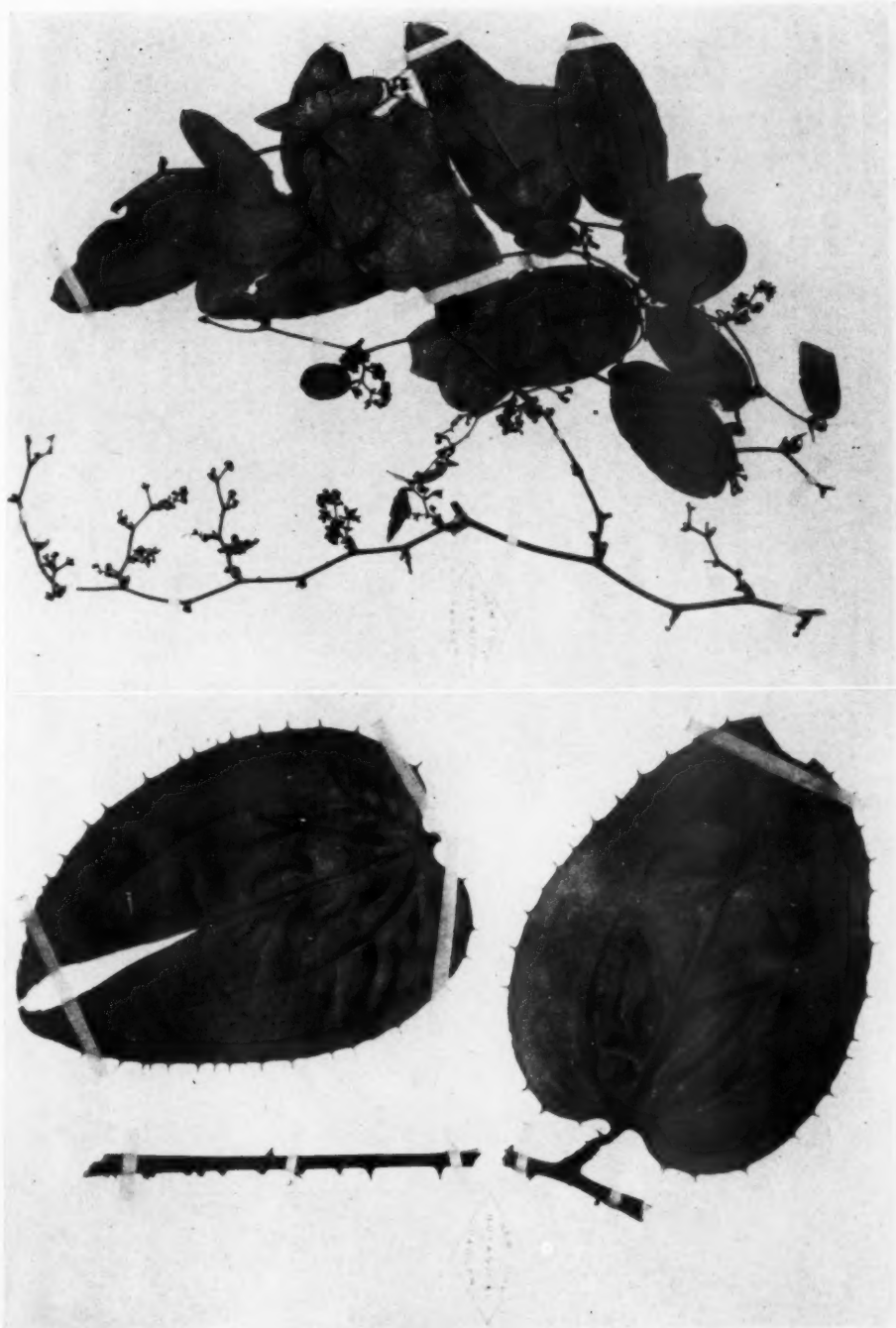


PLATE 22

PLATE 23

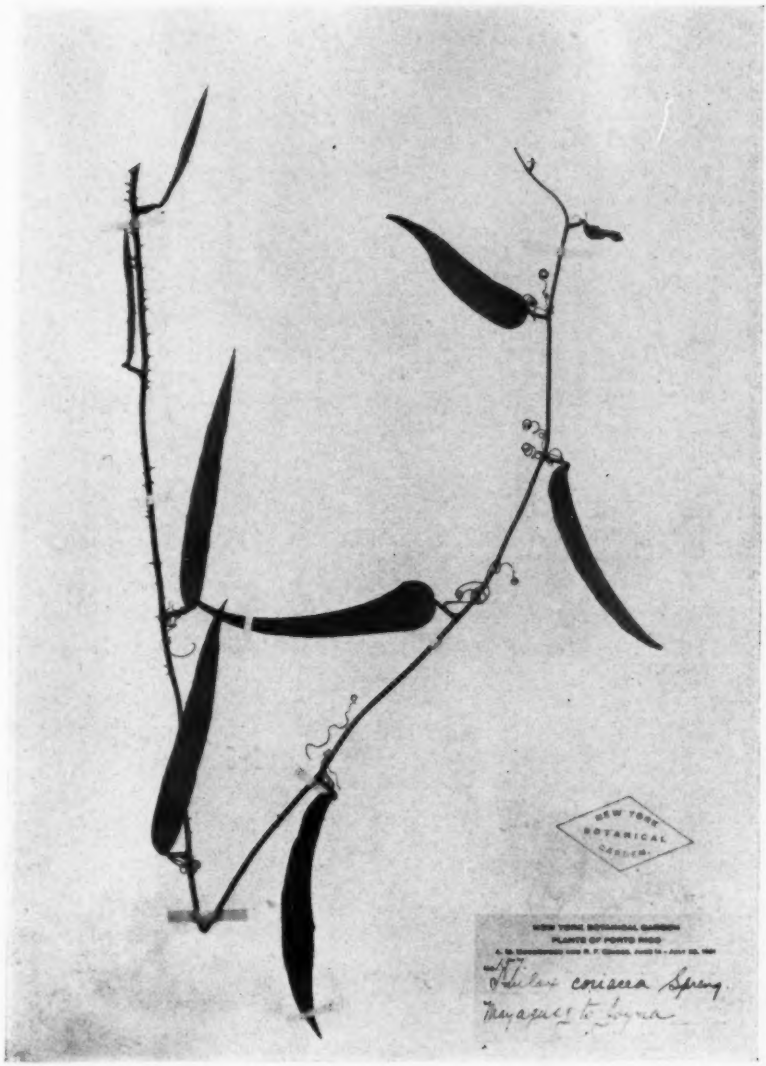
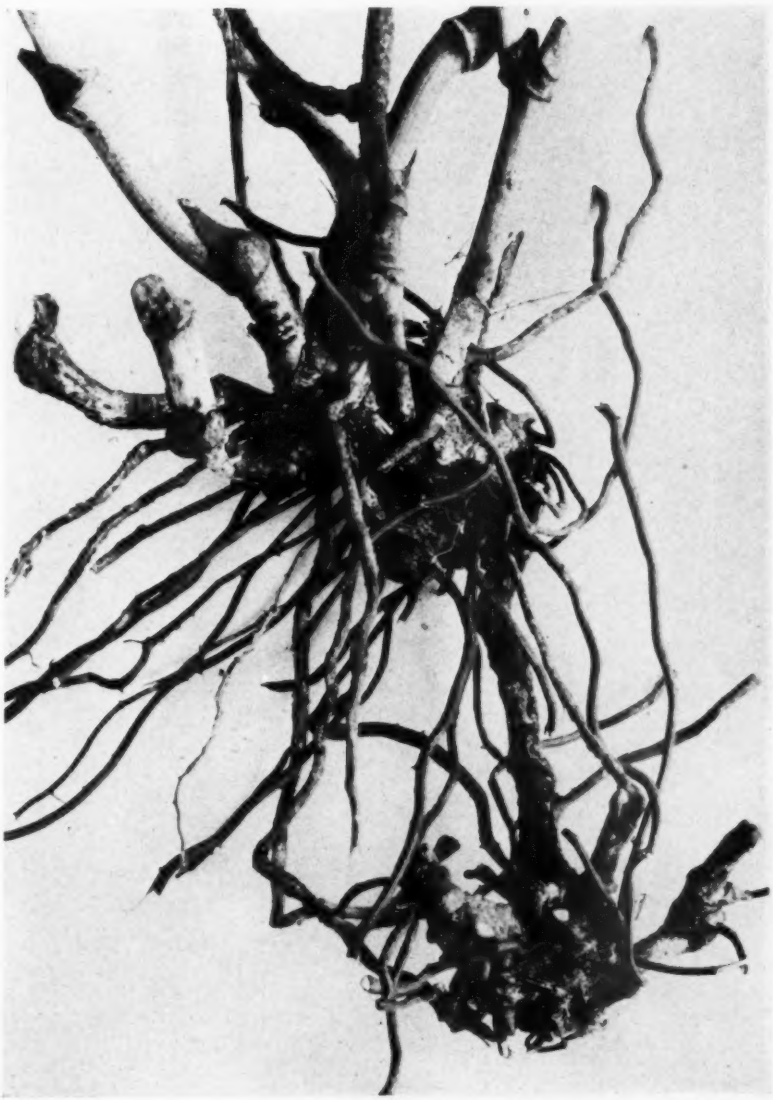

NEW YORK
BOTANICAL
GARDEN
NEW YORK BOTANICAL GARDEN
PLANTS OF PORTO RICO
Phaseolus coriaceus Spreng.
Mayaguez to Luyano

PLATE 24



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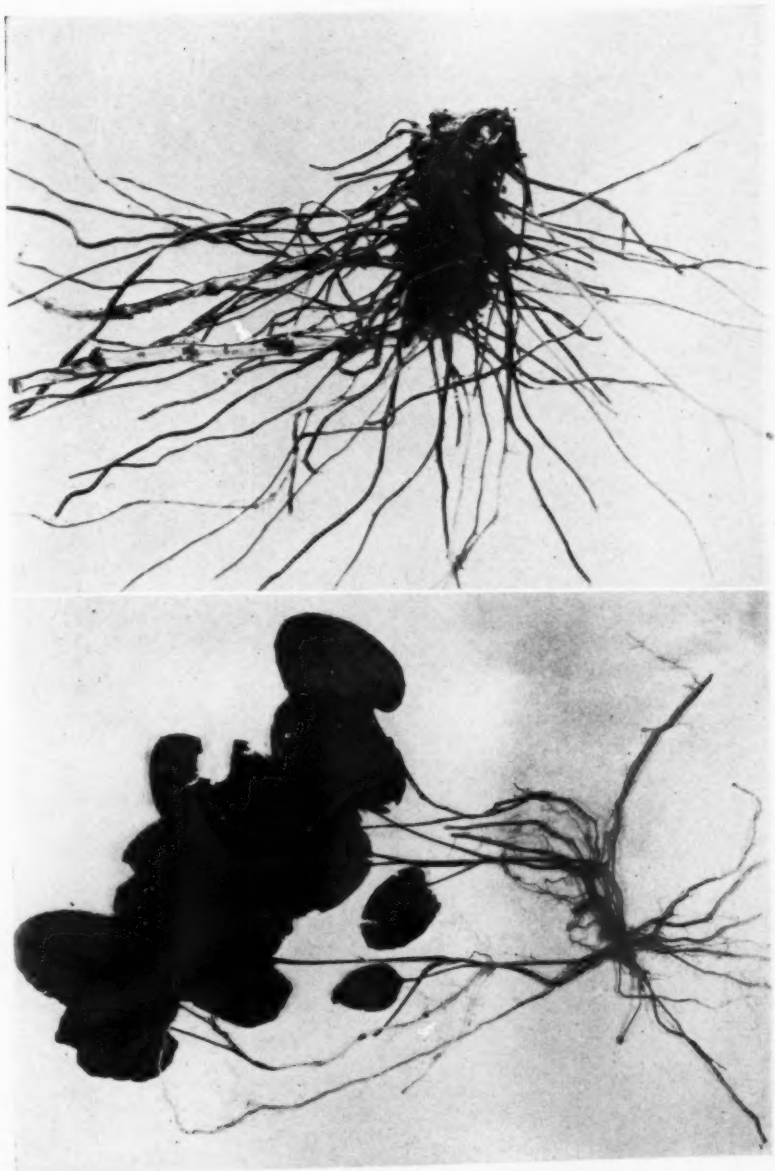

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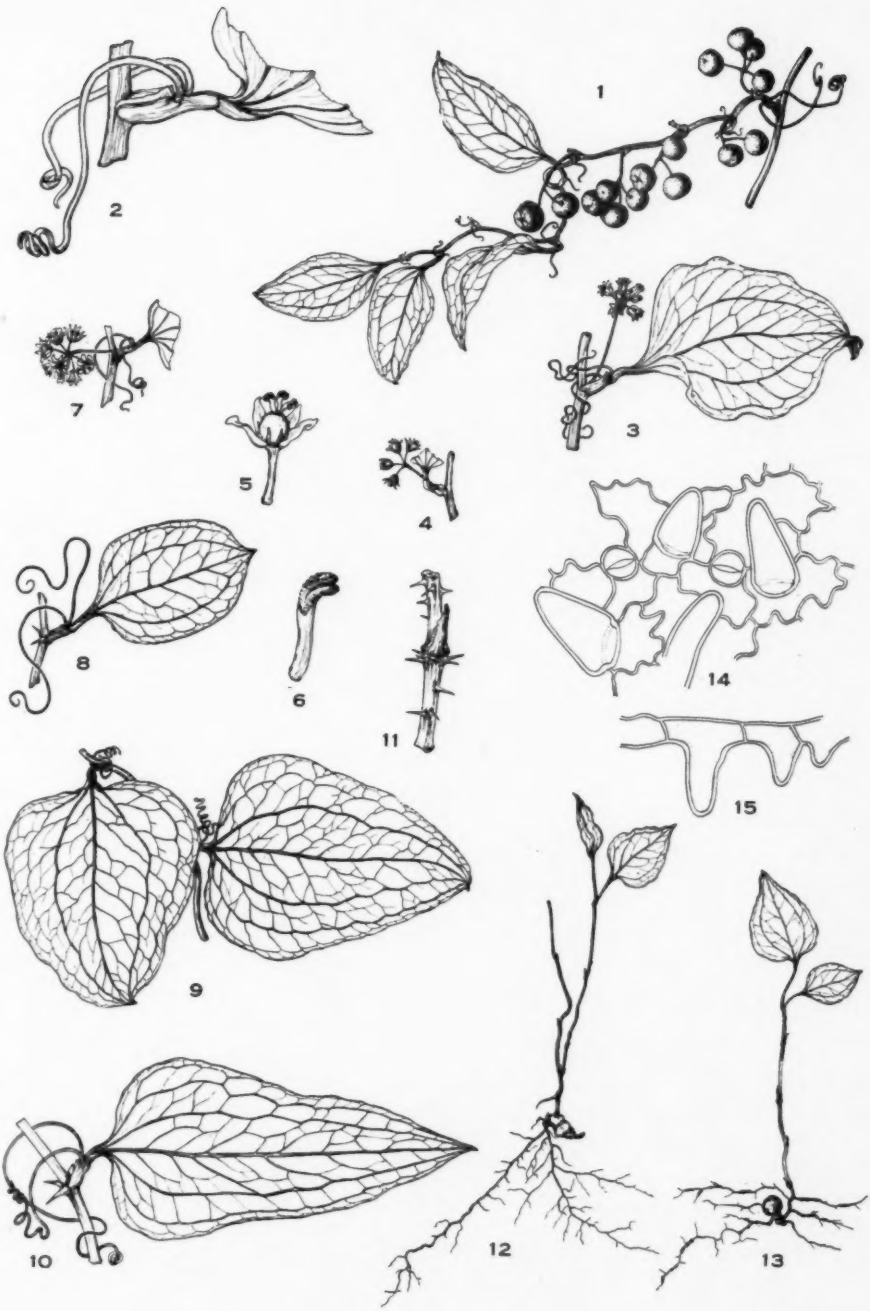

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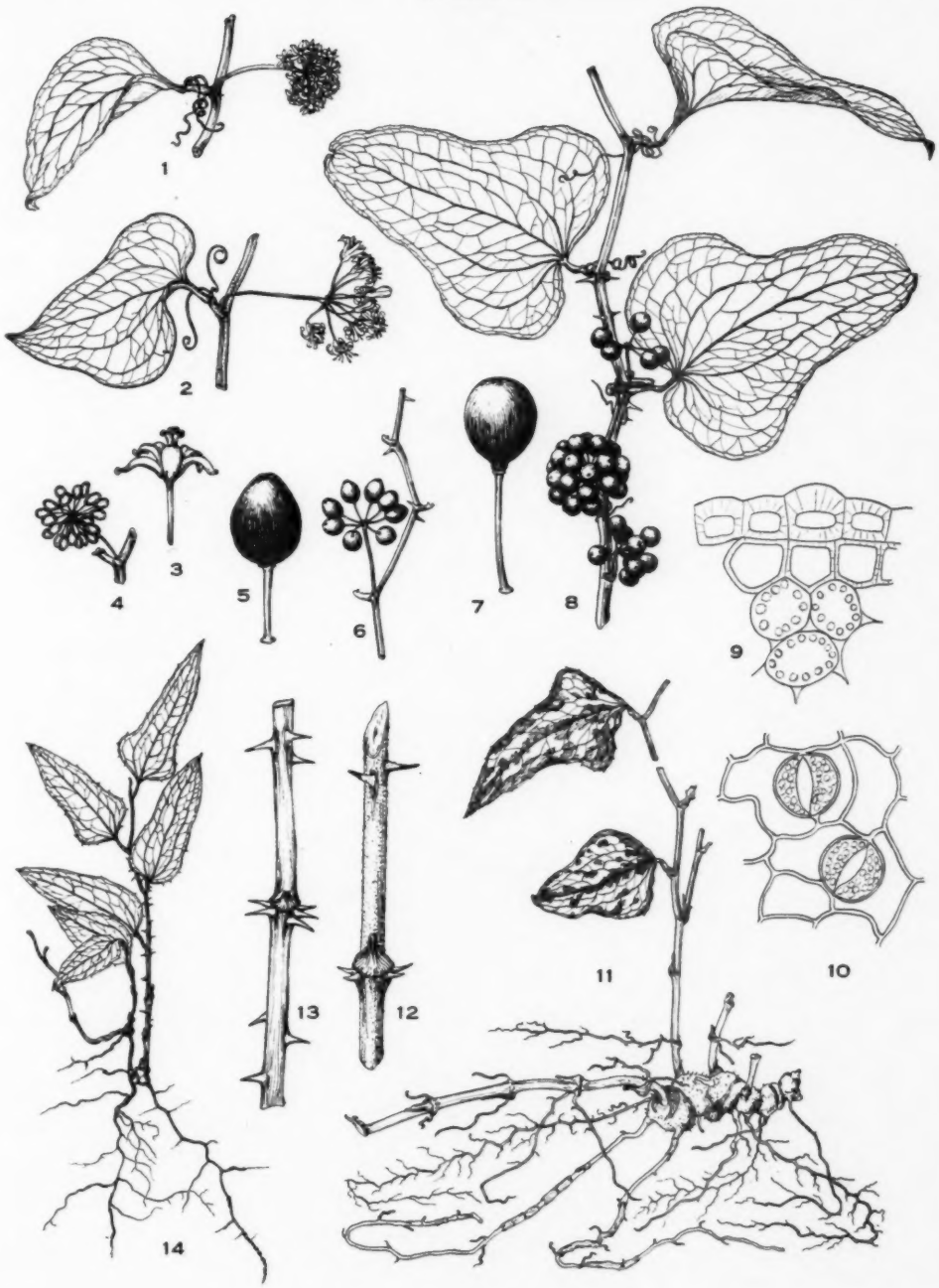

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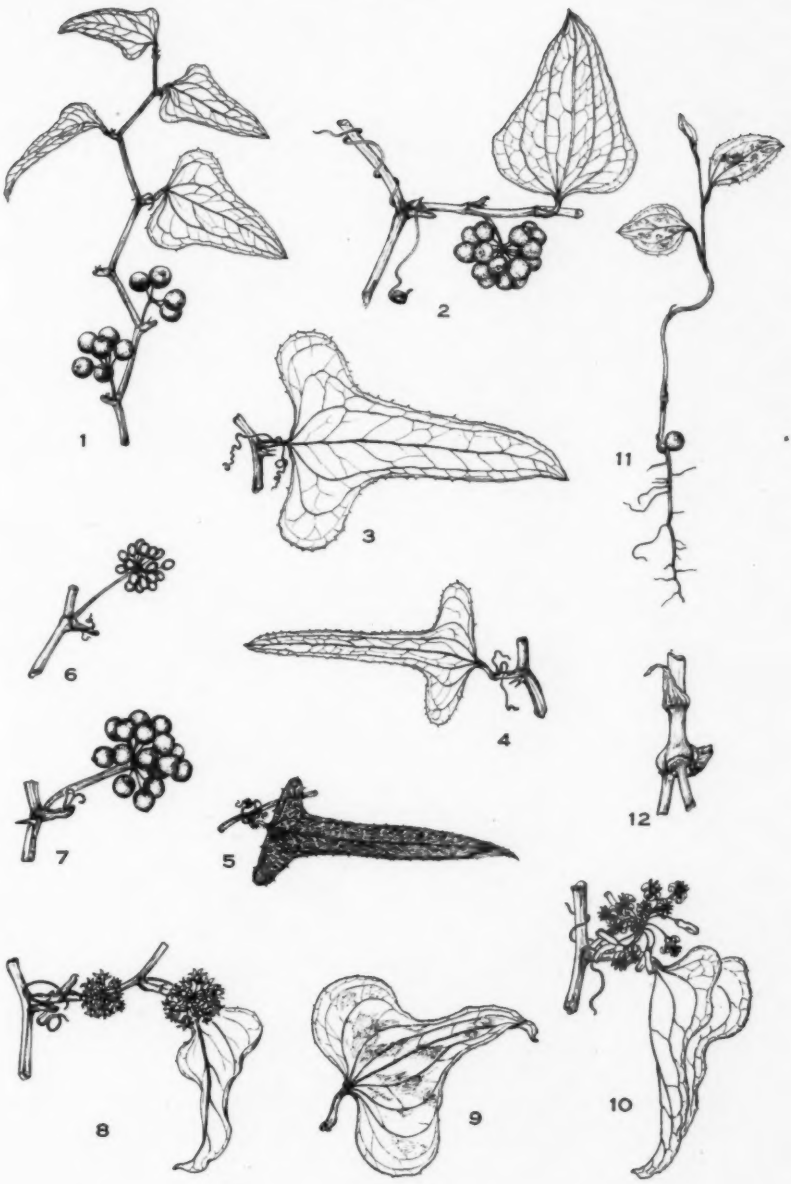


PLATE 29

PLATE 30

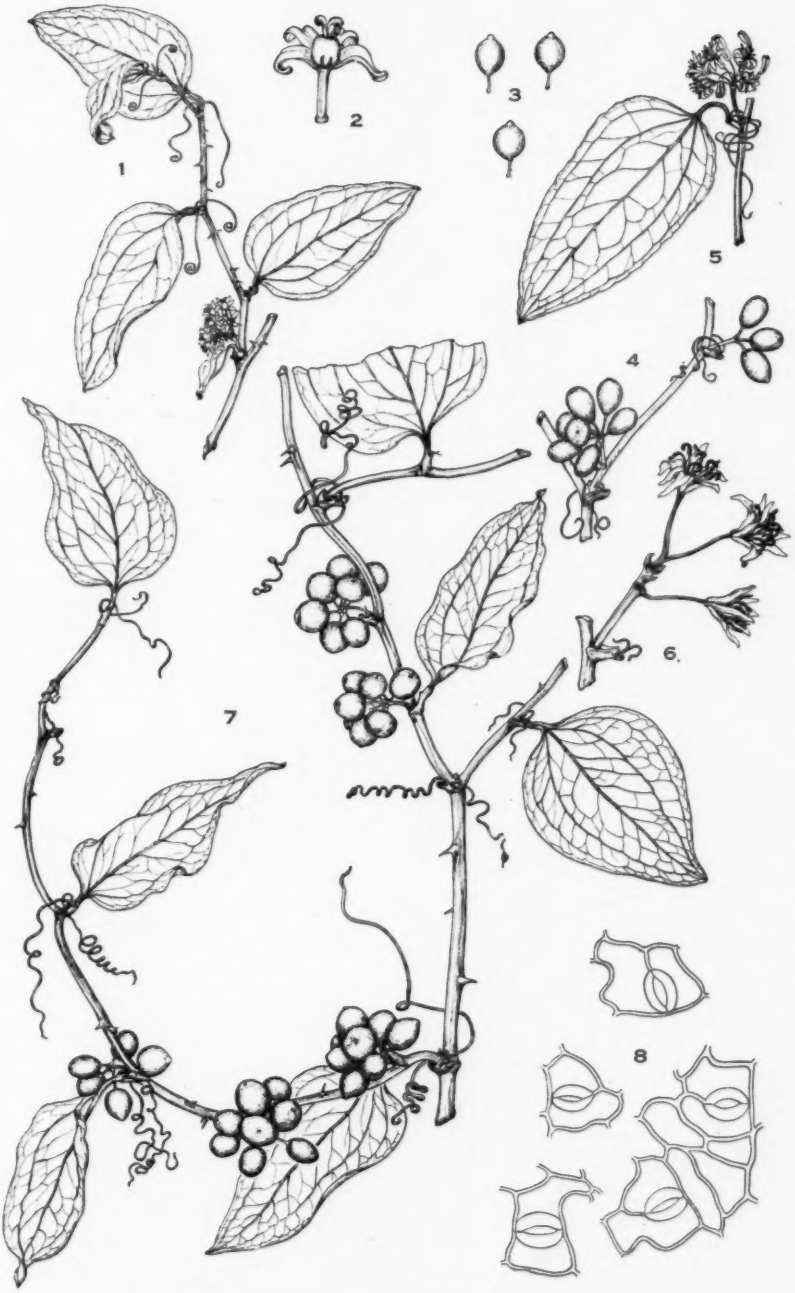
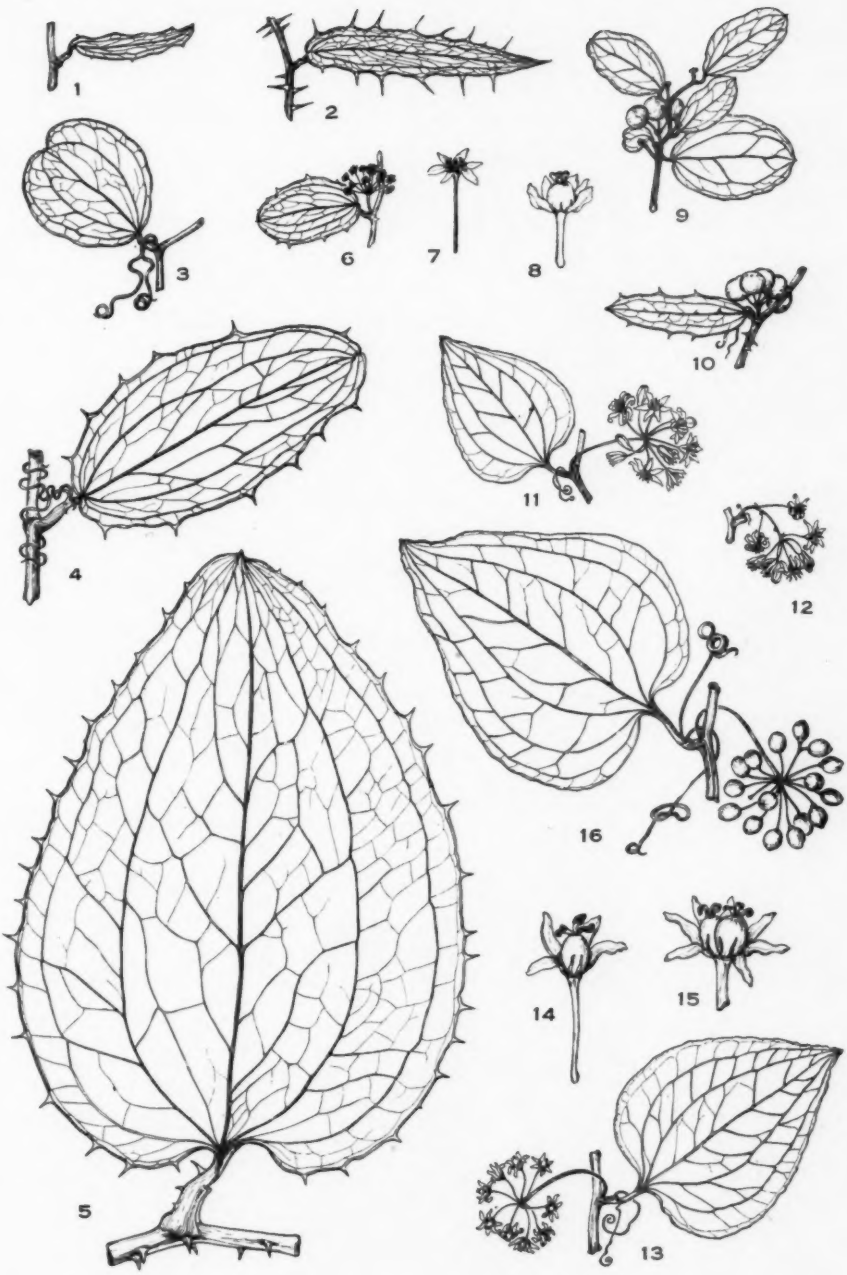


PLATE 31

PLATE 32



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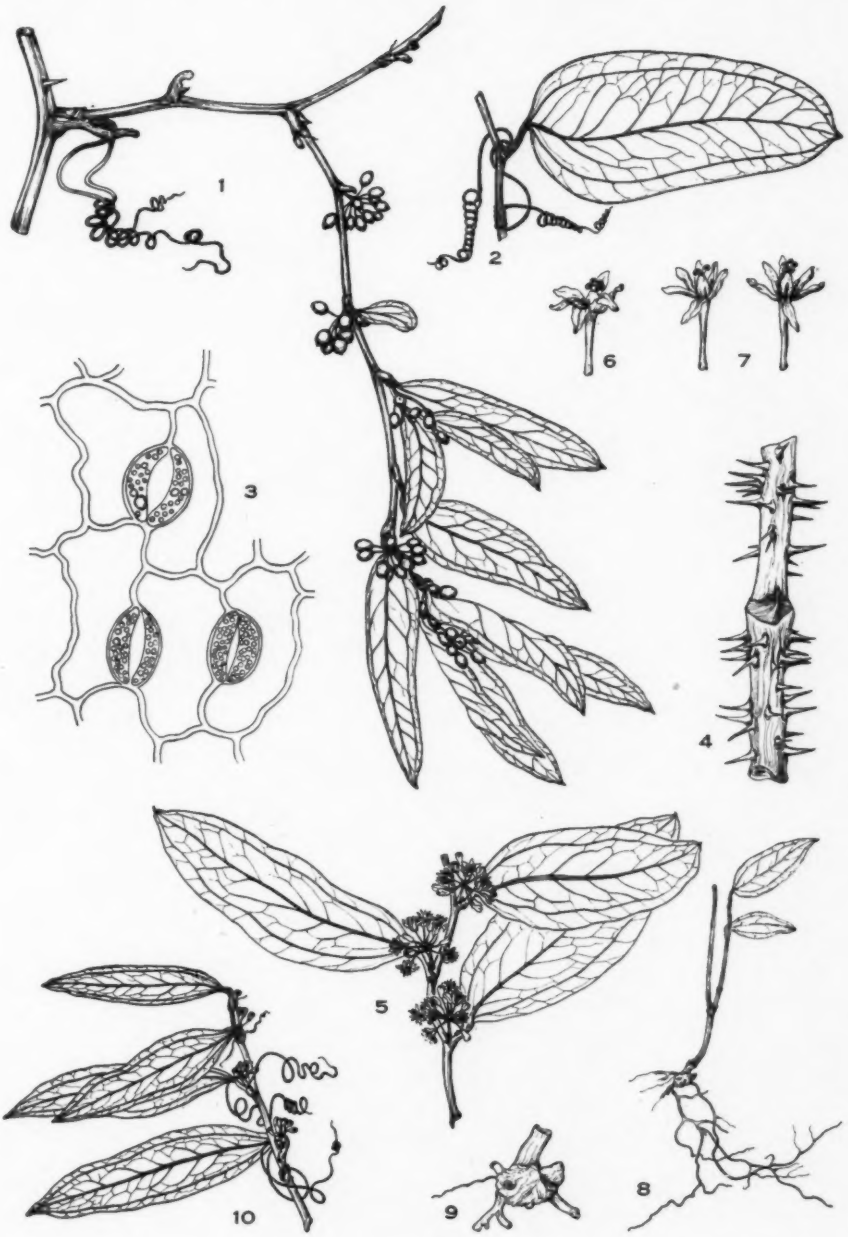
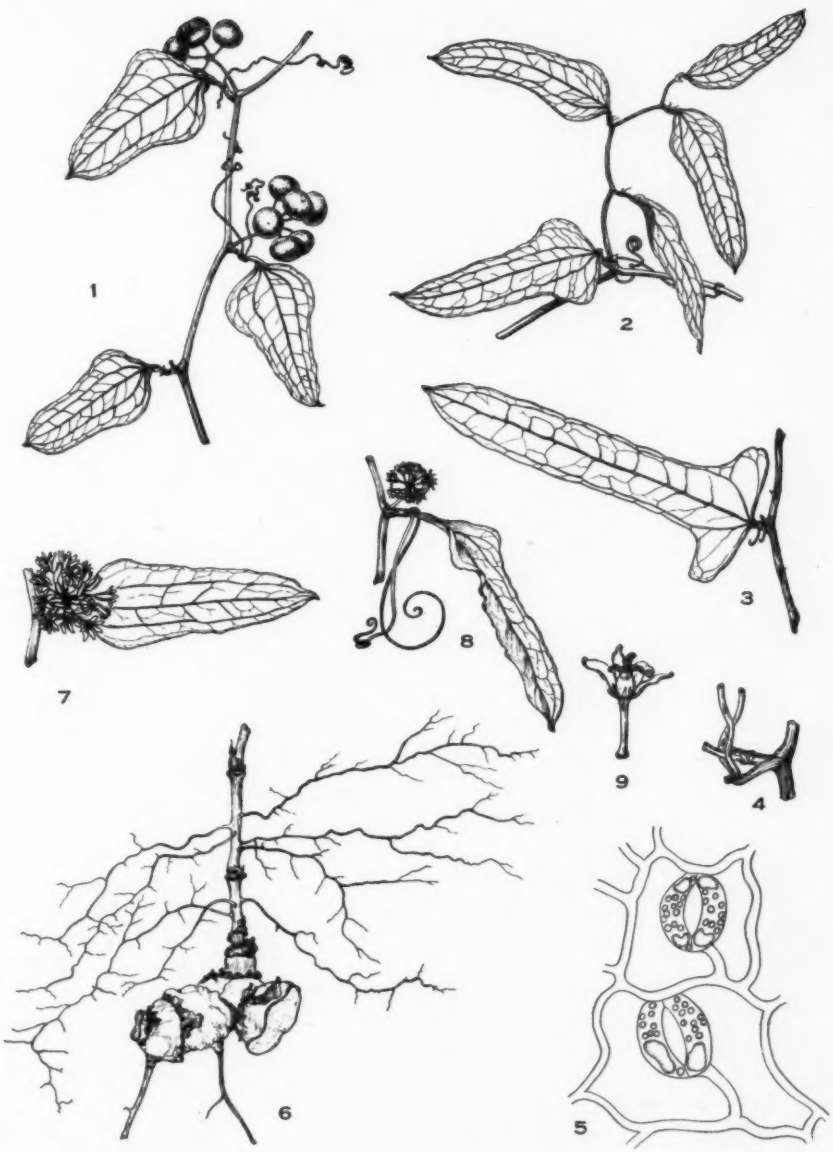


PLATE 34

PLATE 35



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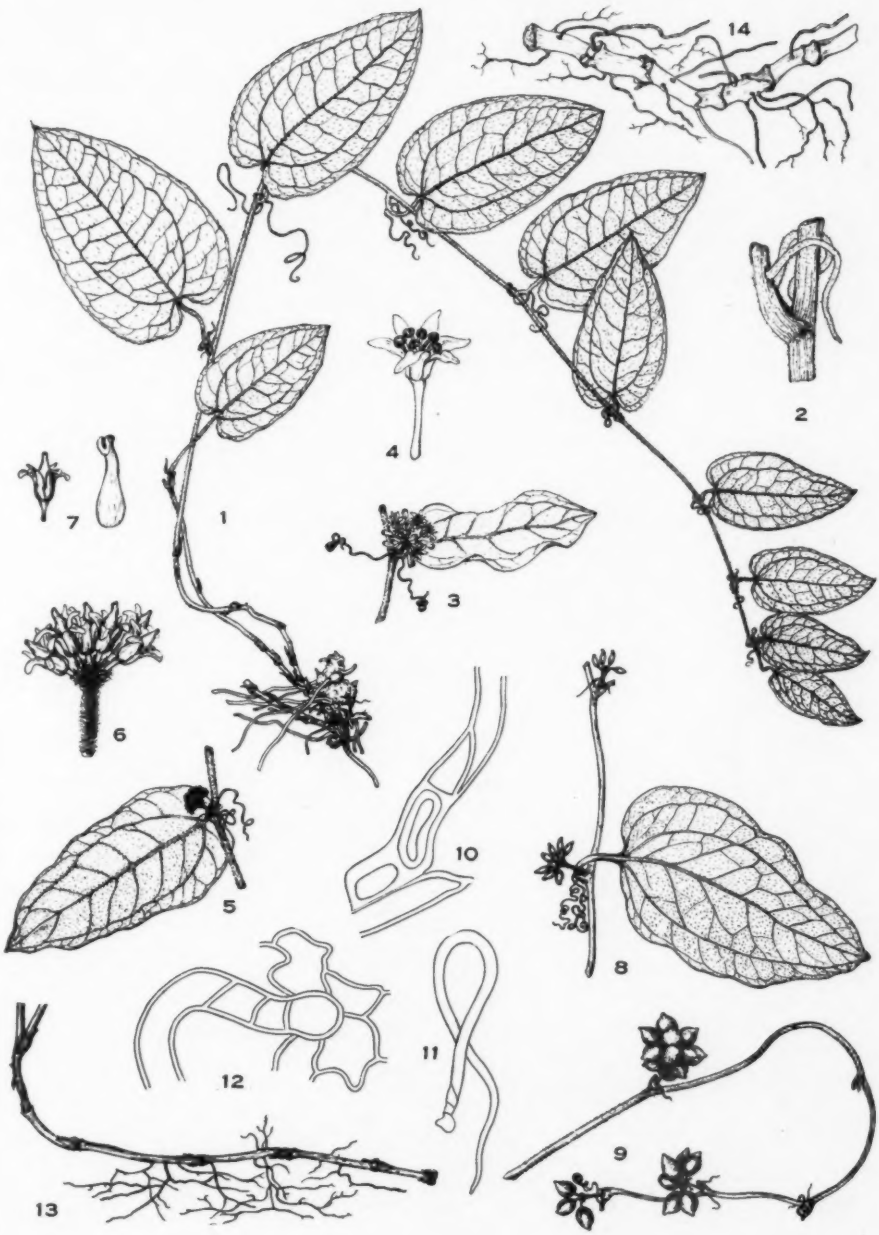

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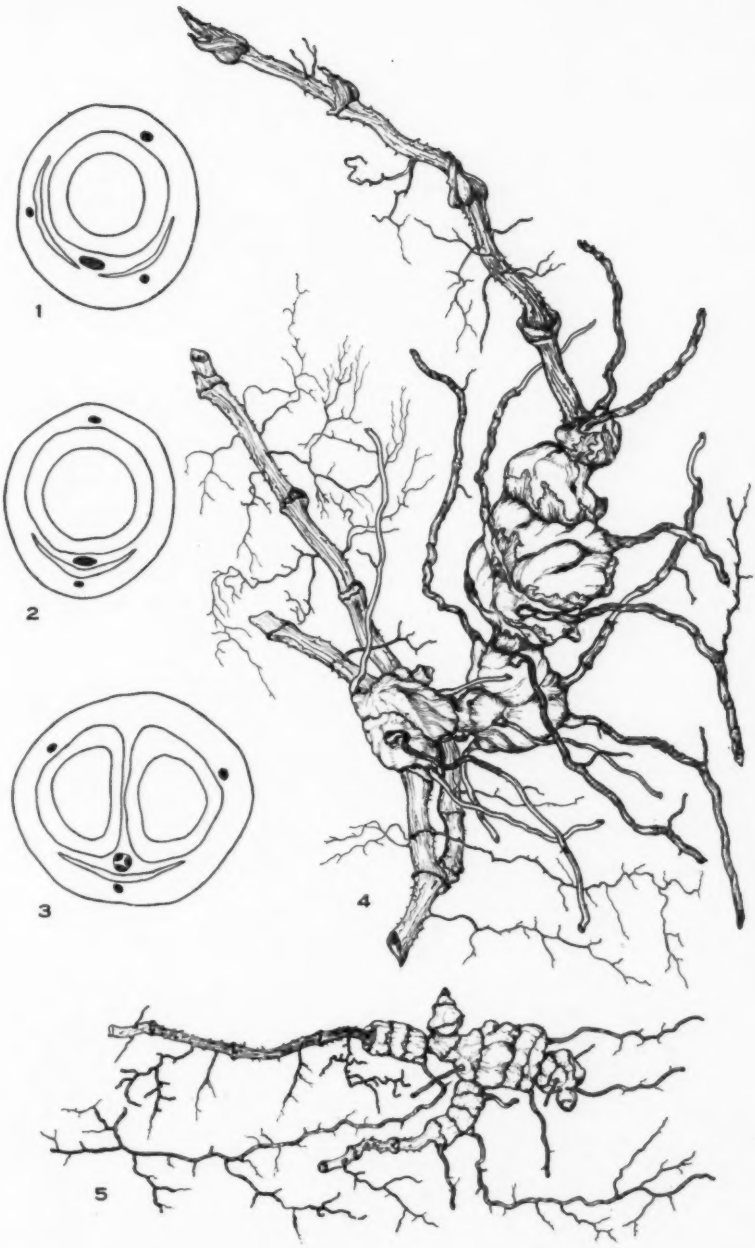

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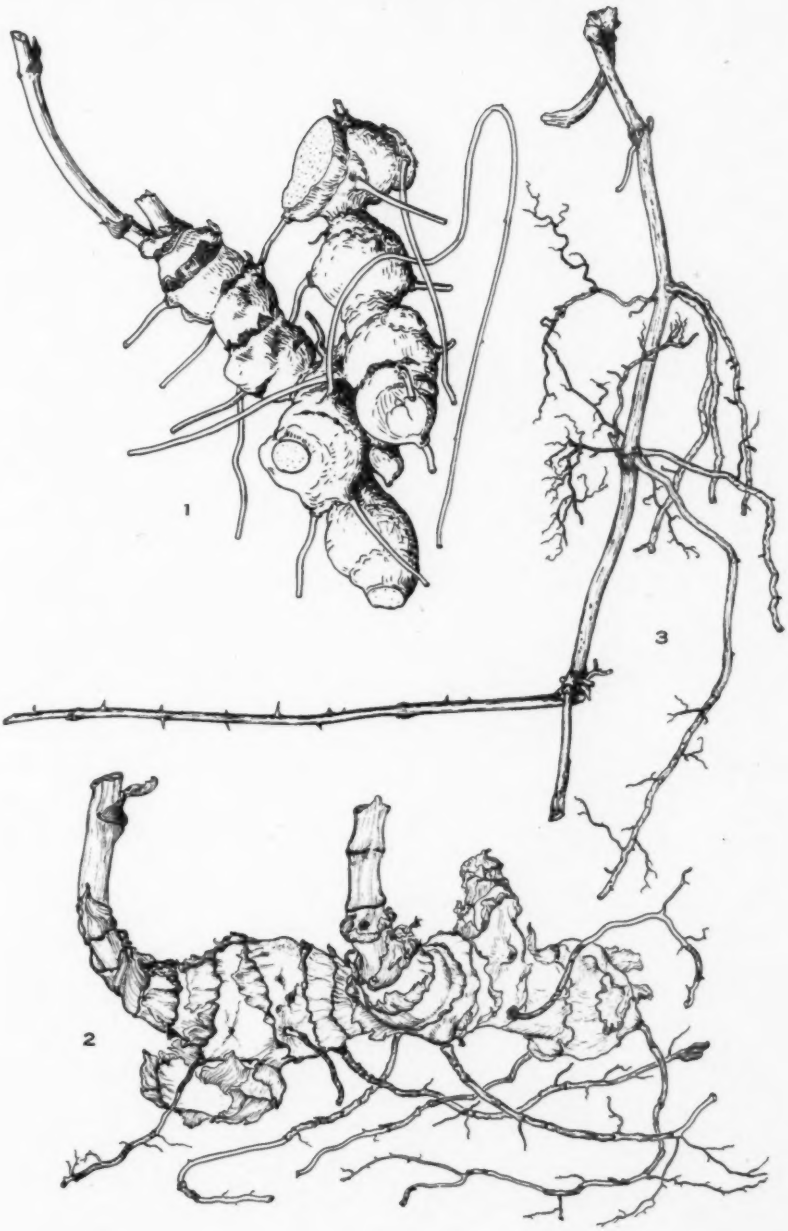

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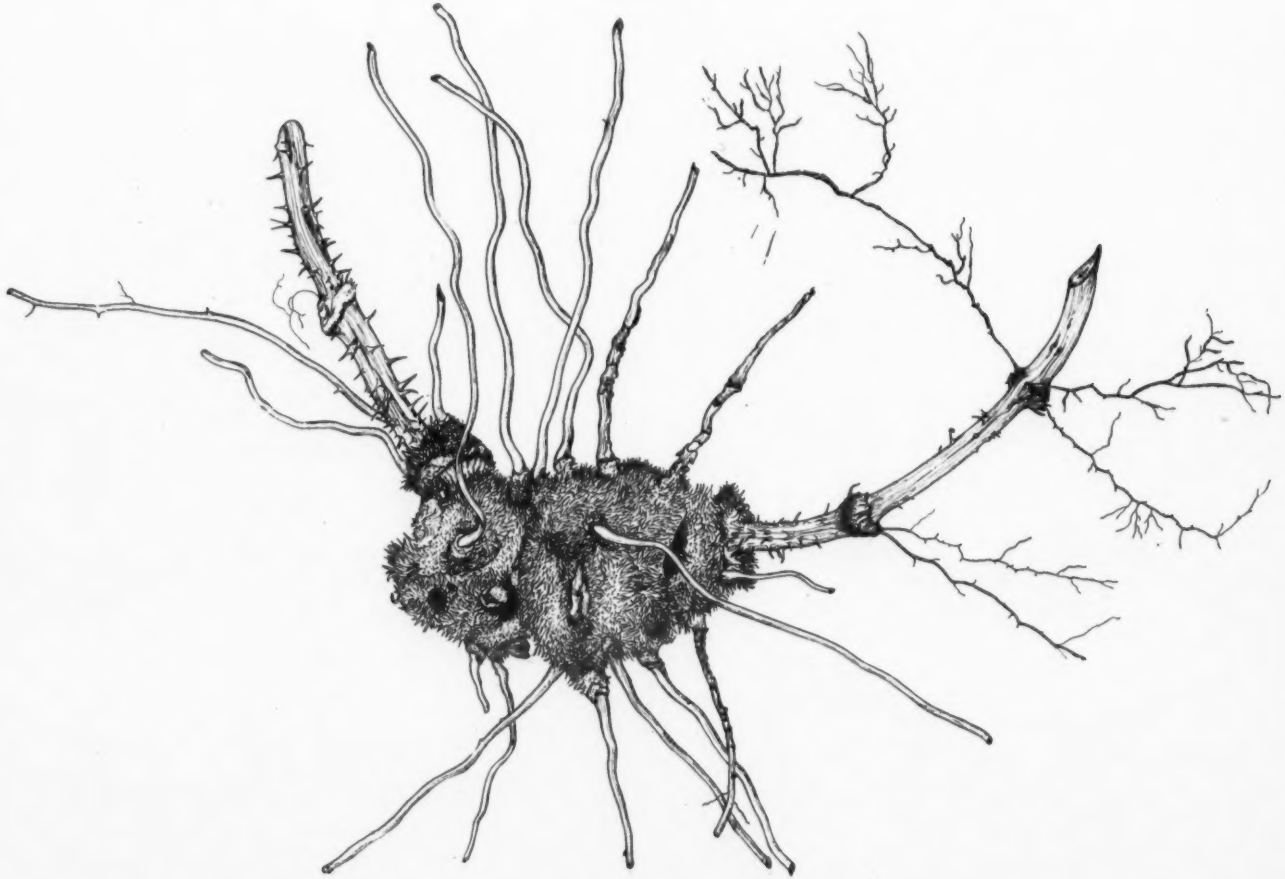

THE SMALLER SPECIES OF PLEUROTUS IN NORTH CAROLINA

By W. C. Coker

Plates 40-52

All but five of the species here treated have a gelatinous layer in the flesh and the larger number of them are very dark to blackish to the naked eye. The gills in most cases are subconcolorous but in a few striking examples are nearly white, contrasting strongly with the cap color. For many years it has been obvious that our species have been too inadequately described to be placed with any certainty, and up to the recent work of Pilát this has been also true of the European species. As in many other cases, Peck has done more than any other American to bring some order out of the confusion.

It is a pleasure to acknowledge the unfailing kindness extended to us by our botanical friends, without which this paper could not have been completed. Dr. Fred J. Seaver of the New York Botanical Garden has sent us for study all material requested and extended all possible courtesies on my several visits to his herbarium. Dr. F. W. Pennell of the Philadelphia Academy of Natural Sciences and Dr. John A. Stevenson of the United States Department of Agriculture, Washington, have both sent examples of *Pleurotus niger* from the original Schweinitz collections. Dr. A. H. Smith of the University of Michigan has given us good material of *P. cyphellaeformis*, and Dr. L. R. Hesler has sent several species from the University of Tennessee Herbarium. The drawings of microscopic details have been made by the writer and inked in by Alma Holland Beers, who also made the spore drawings. The photographs were made by the author with some assistance from several of the students.

KEY TO THE SPECIES TREATED

(A) Cap with a gelatinous layer in the flesh

Cap small to very small, not over 10 or 11 mm. broad (rarely 15 mm.)

Cystidia present

Spores large, elliptic or subspherical, over 7 μ long or thick

Gills white or whitish to light brown when fresh and when dry; cap blackish when wet, more or less whitish with tomentum when dry.

Cap up to 10 mm. broad; spores elliptic; growing on corticated deciduous branches..... *P. approximans*

Cap up to 5 mm. broad; gills creamy white at all ages; spores subspherical; growing on bark of living cedar..... *P. elegans*

Gills blackish (dark brown) when fresh; cap also nearly black when fresh or wet (when dry may be whitened by tomentum or crust)

Plant up to 11 mm. broad, grayish white from a crust when dry; spores elliptic; growing on cedar bark..... *P. crustosus*

Plant smaller, not over 6 mm.; cap nearly glabrous, very black; spores elliptic; growing on deciduous wood..... *P. niger*

Cystidia lacking

Plants not tomentose or strigose (nearly glabrous)

Very small, up to 3.5 mm.; cap dark brown when wet, yellow-brown to blackish

and strongly sulcate when dry; spores subspherical; growing on decorticated coniferous wood ..... *P. striatulus*

Larger, up to 10 (14) mm. broad; sphores elliptic or curved

Gills blackish brown when mature; spores not curved

Cap concentrically or irregularly wrinkled; growing on branchlets of deciduous trees (in our collections all corticated) ..... *P. Silvanus*

Cap not concentrically wrinkled, attached by a distinct stem-like plug; growing on corticated pine branchlets ..... *P. unguicularis*

Gills white or whitish; spores curved; growing on dead herbaceous stems (rarely on woody plants) ..... *P. cyphellaeformis*

Plants tomentose or strigose, at least on proximal part

Cap up to 5.5 mm. broad, drab brown with a well defined disk of dark brown to black strigose hairs over basal area; spores spherical, 4.2–5.4 (5.8) μ thick; growing on deciduous wood or bark ..... *P. Rhacodium*

Cap tomentum not blackish and not confined to a distinct basal disk

Gills creamy white, the margin eroded; spores subspherical, 5–6.5(7) x 6.8–7.5(8.5) μ; growing on bark of living cedar ..... *P. elegans*

Gills not whitish or eroded

Plants very variable in size, most about 5–10(15) mm.

Cap deep gray-brown; spores spherical, 3.7–4.5 μ thick; growing on bark of oak, elm, etc., rarely on the wood ..... *P. applicatus*

Cap pinkish brown with light violet tint when fresh; spores elliptic, somewhat curved, 2–3 x 8–11 μ; growing on deciduous trees *P. violaceo-fulvus* f. *Delastrei*

Plants very small, up to 4 mm. broad, minutely tomentose, larger ones white-strigose at base; blackish brown when wet, light gray when dry, not sulcate; spores subspherical, 3.7–4 x 4–4.5 μ; growing on bark of living cedar *P. carolinus*

Plants large, 1.5 cm. or more broad; conspicuous cystidia present; gills nearly white, close to crowded

Tomentose to villous, at least on basal half; growing on deciduous wood or bark

Cap up to 4–5 cm. broad; gills crowded, narrow (1–1.5 mm.); spores subspherical, 3.2–3.7 x 3.7–4.5 μ; growing on rotting deciduous wood ..... *P. stratosus*

Cap up to 5–10 cm. broad; gills up to 3 mm. wide

Cap whitish or drab; spores subspherical, 5.6–6.5(7.4) x 6.5–8.5(9) μ *P. mastrucatus*

Cap buffy gray to blackish brown; spores elliptic, 3.5–3.8(4) x 6.3–7.7 μ ..... *P. atrocoeruleus* var. *griseus*

Nearly glabrous; gills hardly 1 mm. wide; spores 3.7–4.4 x 6.5–7.8 μ; growing on the ground ..... *P. petaloides* var. *spathulatus*

(AA) Cap without a gelatinous layer

Plants white, or nearly so, very small (5-7 mm.) and delicate

Growing near the ground on grass and mosses; spores elliptic, 2.5–3.7 x 5.5–7 μ *P. hypnophyllus*

Growing on deciduous wood and mossy trunks; spores spherical, 4–6 μ thick *P. candidissimus*

Growing on fallen corticated branches of deciduous trees; spores long pip-shaped, 2.6–3.5 x 6–8 μ ..... *P. septicus*

Growing on bark of dead grape vines; spores 4–5.4 x 5.5–8.2 μ, with distinct longitudinal ridges ..... *P. viticola*

Plants blackish drab when fresh, buffy brown or ashy when dry, 1–3.5 cm. broad; spores variable in shape, most about 5–5.5 x 7–7.5 μ; growing on beds of mosses in woods ..... *P. tremulus*

Pleurotus approximans Peck. Bull. N. Y. St. Mus. **150**: 37-38. 1911.
Resupinatus approximans (Peck) Murrill. N. Amer. Fl. **9**: 241. 1915.

Plate 40 (above) and Pl. 47, figs. 1-6

Plants laterally attached by a thick gelatinous plug, convex, 4–10(12) mm. wide, not at all sulcate or striatulate when young but the margin becoming delicately striatulate when mature, strongly incurved when young, later expanded and at times more or less resupinate; pale to dark smoky brown, then about straw color, translucent, very finely pubescent on stalk and lower half of cap with delicate, short, erect hairs, the marginal half with sparse white flaky scales or becoming quite glabrous, the margin white when young, later concolorous; cap continuous with the plug above, notched at base below, with the margin running down the sides of the plug but not joining to make a continuous margin until later growth in some cases. Flesh composed as follows: (1) a surface film scarcely different from the gelatinous layer below, threads a little more densely woven and bearing the minute agglutinated (when wet) tomentum and a few scattered clumps of crystals, quite transparent except for the crystals; (2) a gelatinous layer up to 600μ thick in large plants, hyaline as glass; (3) an opaque white layer about 125–225μ thick in center of cap, thinning gradually toward the margin and thickening rapidly toward the base where it divides into a watery, subtranslucent, much thicker part (below) and a continuation of the dense white layer above. Clamp connections are plentiful in the cap tissues.

Gills nearly snow white when quite fresh, frosty-looking from the numerous cystidia, becoming creamy when older, rather thin, subdistant, radiating from the base of the plug, ventricose, up to 600μ broad, rounded in front and tapering or rounded behind, mostly short, very few full length, not interveined, very handsome!

Spores (of No. 13541) white, smooth, elliptic, 3.7–4.4 x (5.5)6.5–8μ. Hymenium about 55μ thick. Basidia narrowly clavate, 4-spored, about 6μ thick. Cystidia numerous on sides and edges of gills, 9.3–15(18.5) x 44–77μ, projecting about 15–30μ when dry, very variable in size and thickness of wall but usually thick-walled, usually bent below and with a constricted tip which is delicately encrusted and often with larger crystals around the base of this tip, giving the appearance of a peaked hat on the cystidium.

When dry the cap is still quite smooth (in a few cases faintly sulcate on the very margin) and color only slightly darker, the gills dull white. In No. 13541 two or three caps came in several cases from the same plug, a very unusual condition in this group. On Plate 47, fig. 2, is shown what appears to be a parasitic ascomycete, the dark red-brown filaments made up of short cells being visible here and there in the gelatinous layer. What appears to be the same parasite has been found also in another collection of this species.

We have examined from the New York Botanical Garden a part of what is evidently the type of this species, contributed by Peck himself (on dead maple bark, Sylvan Beach, Oneida Co., N. Y., July 18, 1909). This is to all appearances exactly like our Chapel Hill plants.

North Carolina. Chapel Hill. No. 4024. On dead branches of *Robinia* in Coker Arboretum, Jan. 25, 1920. Spores 4–4.8 x 7–8.5 μ. No. 13541. On bark of a fallen branch of *Liriodendron*, Dec. 27, 1943. No. 13551. On dead corticated *Wisteria* vine, Coker Arboretum, Jan. 15, 1944. Spores 3.7–4 x 7.5–8 μ. Cystidia as in above number.

Pleurotus elegans n. sp.

Plate 40 (below) and Pl. 47, figs. 7–12

Single or sparsely gregarious; cap convex, up to 4–5 mm. wide, often much smaller, laterally attached by a stalk-like plug about 1 mm. long and 0.5 mm. thick which is white on the lower side and black above but densely white-villose on both sides; cap not marginate behind, not striate or sulcate except on about ½ mm. of the margin, nearly black except for the conspicuous white villose pubescence extending from the base over the proximal third or half of the cap, fading to a puberulence toward the abruptly whitish margin. Flesh very thin, tough, black in bulk, consisting of: (1) a very thin blackish surface layer bearing the pubescence which collapses in age; (2) a clear, hyaline, gelatinous layer about 200–226μ thick; and (3) an opaque lower layer which gradually thickens from the thin margin to the center and runs down into the gills to form their trama.

Gills distant, thickish, broad, only a few (4 or 5) that are of full length, about milk white both when wet and when dry, more or less rounded at the inner ends which just reach the little plug; margins uneven and irregularly toothed.

Spores (of No. 13530) subspherical to sub-pipshaped, smooth, 5–6.5 x 6.8–7.5(8.5)μ. Hymenium about 22μ thick; basidia 4-spored, about 6.8–8μ thick. Cystidia small, 12–14μ thick, extending about 15–20μ, gradually tapering and more or less heavily encrusted, the embedded part not encrusted and with thicker walls than the other cells of the hymenium; cystidia present, so far as observed, only on or near the margin of the gills but not numerous and often not easily found (in one case even in good sections not found at all); associated here and there with other peculiar cells with apiculate tips ending in a globular swelling (Pl. 47, fig. 10).

This is a well-marked species, easily distinguished from our two other new species on cedar by its white gills with eroded margins, lateral attachment by a stalk-like plug, and the large round spores.

North Carolina. Chapel Hill. No. 10350. On bark of living cedar at "The Rocks," Jan. 15, 1937. No. 10355. On same tree as above, Jan. 17, 1937. No. 13530 (type). On bark of living cedar in woods west of "The Rocks," Nov. 9, 1943. No. 13532. On same tree as just above, Dec. 5, 1943.

Pleurotus crustosus n. sp.

Plate 41 (center) and Pl. 48, figs. 7–9

Cap 2–11 (usually 3–7) mm. broad, cup-shaped to conchate, excentrically sessile by a slightly elevated disk, strongly sulcate both when fresh and when dry, minutely granular-crusted all over, not hairy toward base, when wet blackish brown with a lighter smoky brown margin, when dry light grayish (nearly white) or brownish all over. Flesh blackish, tough, elastic, very thin (hardly 0.5 mm. thick), tasteless and odorless, composed of: (1) a very thin (about 30μ thick), nearly black cuticle with black excrescences of minute, gnarled and swollen tubercles which have numerous grain-like, whitish crystals on their surfaces; (2) a translucent, pale russet brown in section, gelatinous layer about 300–350μ thick with the hyphae not few and perpendicular but dense and interwoven; and (3) a lower black, thin, dense layer about 45–50μ thick next the hymenium.

Gills subdistant, up to 1.3 mm. wide, rounded at the point of attachment,

undulate and veined, thickish, dark russet brown (color of cap), many short, the minutely granular margin paler.

Spores (of No. 3896) white, smooth, oblong-elliptic, 3.7–4.2 x 7.4–9.5μ, most about 8μ long. Basidia short-pyriform, 5.5μ thick, with 4 slender sterigmata. Cystidia present, fusiform, oblong or oval, of various sizes, 18–30 x 52–68μ, counting the crystals (one found without crystals, 7.6 x 40μ), widely scattered on both margins and sides, peculiar (as in *P. niger*) in being completely or almost completely embedded in the fresh condition (projecting about 14–18.5μ when dry) and heavily encrusted on basal half or nearly all over with large crystals.

When fresh or rewet the minute surface particles are invisible to the naked eye but faintly paler under a lens, with the appearance of miniature frog warts. This is quite different from any other of our species. The complete absence of tomentum, the crusty surface which is whitish or brownish when dry, the irregular and undulating gill margins, the expanded form, long spores, the peculiar cystidia, and habit of growth on cedar bark are distinguishing characters. When looked at under moderate power the cystidia with their crystals will appear as dark blotches on the sides of the gills. In favorable cases the circular attachment of the cap can be seen to be fringed by a narrow ring of dense white fibers, closely appressed to the bark, just as in the case of *P. Silvanus*.

This species is structurally nearest *P. niger*, from which it differs in larger size, distinct pale crust (most obvious when dry), more slender spores and growth on corticated cedar poles (*Juniperus virginiana*).

North Carolina. Chapel Hill. No. 3896. On bark of cedar poles, at "The Rocks," Dec. 14, 1919. No. 13539. On bark of cedar poles in Coker Arboretum, Dec. 26, 1943. Spores (print) rod-elliptic, about 4.5 x 9.3 μ. No. 13545. Same place as No. 13539, Jan. 3, 1944. Spores oblong-elliptic, 3.7–4.2 x 7.4–9.3 μ. Cystidia up to 70 μ long.

Pleurotus niger Schw. Syn. Fung. Car., p. 90 (No. 817). 1822.

Plate 41 (above) and Pl. 48, figs. 1–6

Through the kindness of Dr. J. A. Stevenson and Dr. F. W. Pennell, we have been able to study authentic examples of this species from Schweinitz's Herbarium now in the Michener collection in Washington and from the Schweinitz Herbarium in the Academy of Natural Sciences in Philadelphia. In the Washington material there are two grown plants and one young one on rotting deciduous wood, said by Schweinitz to be *Juglans alba*; from Philadelphia one plant was sent for examination. The plants from both sources were identical, and from our study may be described as follows.

Cap 4–5 mm. broad, nearly circular, applanate, convex, laterally and broadly attached, not resupinate, black, nearly glabrous (minutely granular in the grown specimens), very faintly striatulate on margin when revived, no noticeable fibers at base, young plant minutely tomentose with gray, tufted fibers. Flesh largely a dark jelly, moderately thick, covered with a translucent membrane with blackish granules.

Gills blackish brown when revived, thick with blunt edges, rather close, wavy, moderately broad (hardly a mm.) and more or less rounded behind; many short.

Spores ovate-elliptic, smooth, (3.8)4–4.5(5) x 7.4–9.5μ. Hymenium about

37μ thick. Cystidia present, fusiform, 10.5–16 x 24–63(75)μ, the central part of the cell almost obscured by a mass of large pale crystals that surround it. When soaked overnight the crystals fall away in large part and expose the peculiar cystidium cell which is thick-walled, deep red-brown in lower half, hyaline in upper part which projects above the hymenium about 15μ or less. The cystidia occur not only throughout the hymenium but small irregular ones occur also on the surface of the cap at or near the margin. These cystidia do not seem to project at all but are prostrate and somewhat embedded.

This species has been misunderstood and no one seems to have studied the Schweinitz plants before. (Lloyd looked at those in Philadelphia and passed them up.) It belongs in a peculiar group with our *crustosus* and is distinguished by small size, very black color throughout, glabrous cap, thick, not distant gills, large ovate-elliptic spores, peculiar cystidia both on gills and cap surface, and growth on deciduous wood. This is the only species we have studied that has cystidia on the cap surface. These latter are essentially like those of the gills, red below and strongly encrusted, but smaller and more variable in shape.

None of the specimens in herbaria we have seen, determined as *niger*, are this species. Most of them are *Silvanus* Sacc., a few are *Rhacodium*, and one is *striatulus*.

Pleurotus striatulus Fr. Syst. Myc. **1:** 193, 1821; Hymen. Eur., p. 181. 1874.

Plate 42 (above) and Pl. 49, figs. 1-3

Closely gregarious in large numbers; cap very small, up to 3 mm. (Peck says 2–4 lines), attached by a point, campanulate or when on a perpendicular surface deeply cup-shaped and lightly adnate on the near side, dark brown, apparently glabrous, lightly sulcate only on about 1 mm. of the margin, the very edge a little crenate and paler. Flesh very thin, hardly ½ mm., composed of: (1) a very thin gelatinous pellicle which is more or less opaque from irregular areas of minute granules and is finely roughened by irregular agglutinated projections; (2) a translucent gelatinous upper layer about 400μ thick near center (thinning to margin) and descending into the gills as a thin plate to make the central part of their trama; and (3) a thin almost black, opaque layer about 40μ thick next to the gills and descending into the gills as a thin layer just under the hymenium.

Gills broad, think, radiating around an excentric, glabrous disk, long ones few (about 5) but short ones up to 12–15, color yellow-brown, about honey color, the margins whitish with minute granules, not interveined.

Spores (of No. 10323) subspherical, 4.5–5.5(6) x 5.5–7(7.5)μ. Cystidia lacking.

When dry the plants shrink to only one or two mm. and are blackish to the eye, *strongly sulcate* from near the base, under a lens dark or lighter yellow-brown, subtranslucent and about the color of raisins with a delicate whitish bloom or frost, the gill margins and cap margin also white-frosted. The threads of the jelly layer are light brown and toward the dark layer below they become more closely placed and give that area a light brown color. All collections we have seen were on rotting, decorticated, coniferous wood.

As discussed under *P. applicatus*, that species and *striatulus* have been badly confused. Pilát considers them the same, but whatever may be the plants he is considering, the ones we treat under these names are very different, and we

are in agreement with all or nearly all American authors (as Ravenel, Peck, Underwood, Murrill, et al.) in this interpretation.

Illustrations: Cooke. Ill. Brit. Fungi, pl. 212, fig. b; also pl. 244 (below), as *applicatus*.
Fries. Icon. Hymen., pl. 89, fig. 5.
Gillet. Champ. Fr., Hymén., pl. 240 (535), fig. 3.
Patouillard. Tab. Anal. No. 106.
Pilát. Atl. Champ. Eur. **2**: pl. 17, as *applicatus*.

North Carolina. Wake County. No. 9987. On rotting coniferous wood, Mitchell's Mill, March 1, 1935. Spores 3.5–4.2 x 4.6–6.5 μ.
Bladen County. White Lake. No. 10323. On rotting cypress log, Dec. 6, 1936 (J. N. Couch, coll.).
Mt. Sterling. On decorticated coniferous wood, Aug. 2, 1936. Hesler, No. 9273, as *P. niger*. Spores subspherical, 4.2–5.2 x 5–6.3 μ.
Tennessee. Mt. Leconte. On decaying coniferous wood, May 6, 1935. Hesler, No. 4932, as *P. atropellitus*.

Other collections seen are the following.
In the New York Botanical Garden:
South Carolina. Ravenel, Fung. Car. Exs., Fasc. 4, No. 2.
Alabama. Auburn, Dec. 1896, L. M. Underwood.
New York. Syracuse. On cedar logs, Oct. 1888, L. M. Underwood Herb.
New Hampshire. White Mountains.
British Columbia. Macoun, 1887 (as *P. niger*).
In the Peck Herbarium at Albany:
New York. Greenbush. On pine log, Peck, coll.
Schuylerville. Oct. 12, Peck, coll.

Pleurotus Silvanus Sacc. Michelia **1**: 1. 1877.

Plate 42 (center) and Pl. 49, figs. 4, 5

Cap (2)2.5–8.5 mm. broad, shell- or cup-shaped, attached by a central or excentric disk or usually by a distinct tubercle, smoky gray or very dark drab, nearly black when young with a rather sparse, white, frosty puberulence which gives a faint bloom but disappears quickly, later black and practically glabrous but under a lens seen to be very delicately marked with scattered appressed white wisps or flakes until quite old, surface minutely granular and irregularly rugose-wrinkled more or less concentrically over most of its area except on the delicately striatulate margin; no villosity at all at point of attachment. Flesh thin, toughish, black, tasteless and odorless, composed as usual of three layers: (1) a thin crust about 15–30μ thick, black in transmitted light; (2) a thick gelatinous layer about 300μ thick at base, thinning gradually to margin, blackish in bulk, in section hyaline with pale brown threads, and descending into the gills to make the central part of their trama; (3) a very dark brown layer above the gills, about 75μ thick near center, thinning to about 15μ at margin, and descending into the gills to make the subhymenium.

Gills nearly color of cap at all ages but with a purplish tint, when very young appearing whitish from a delicate frosting but soon clear dark brown with a faint but distinct tint of purple, then blackish, subdistant, rather thick with blunt edges, not interveined, about 5–7 long ones and inserted ones of several lengths, up to 1 mm. wide, radiating from near point of attachment where they are abruptly rounded; margins paler and granular when quite fresh, soon becoming black.

Spores (of No. 3845) white in a good print, smooth, elliptic, 3–3.6 x 5.5–7.5μ, most about 7μ long. Hymenium about 33μ thick, the basidia narrowly clavate. Cystidia lacking.

This species is distinguished by its nearly glabrous and nearly black (even in youth except for the puberulence) cap surface which is delicately wrinkled concentrically and usually attached by a plug-like tubercle, and by its narrowly elliptic spores in which the contents soon collapse to one side causing the spores to appear slightly curved under low power. The plants are also peculiar in their slight shrinkage in drying, e.g., the largest plant in No. 13535 (see photograph) was 6.5 mm. broad when fresh and was 5 mm. broad when dry and very little changed in shape.

In Chapel Hill this species is more often met with than any other but the colonies are sparse. It is also frequently found in herbaria but is always misnamed, usually as *P. niger*. Pilát is the only one, so far as we know, to report this from America by its right name. His last entry under specimens is "Maine (Blake, 1859, in herb. Burt,—as *Pl. niger* Fr.)." The following collections at the New York Botanical Garden determined as *niger* are this species: Ravenel, Fungi Car. Exs. No. 1; Auburn, Alabama, F. S. Earle, Jan. 18, 1897; Ocean Springs, Mississippi, Ellis and Everhart, N. Amer. Fungi Exs. No. 2008, and also F. S. Earle, Feb. 1, 1887, No. 204; Louisiana, near St. Martinsville, A. B. Langlois, No. 2468.

Illustrations: Pilát. Atl. Champ. Eur. **2**: pl. 20, 21, fig. 1, 4, 5, 7, and Figs. 21, 82.

North Carolina. Chapel Hill. No. 3845. On dead limb of peach or cherry, Dec. 9, 1919. No. 3954. On fallen branchlets of oak, Jan. 17, 1920. No. 13533. On corticated fallen branch of sweet gum, Dec. 9, 1943. Spores 3.5–3.8 x 6.2–8.2 μ. No. 13535. On dead sweet gum twig, Dec. 9, 1943. Spores 2.8–3.5 x 6–7.4 μ, very delicate and collapsing overnight in a damp chamber. No. 13543. On corticated branch of a deciduous tree, Dec. 27, 1943. Spores 3–3.7 x 6.6–7.5 μ. No. 13553. On corticated branch of a deciduous tree, Jan. 19, 1944. No. 13581. On rotting corticated branch of a deciduous tree, March 13, 1944. No. 13582. On dead branch of *Liriodendron tulipifera*, April 12, 1944.

Tennessee. Knoxville. On dead corticated apple branch, University Farm, April 6, 1935. L. R. Hesler, No. 6205, as *P. atropellitus*.

Pleurotus unguicularis Fr. Elen. Fung. **1**: 24. 1828.

Plate 42 (below) and Pl. 49, figs. 6–8

Cap nearly circular, up to 6(7) mm. wide, attached by an excentric stalk-like, solid, terete, equal tubercle up to 1 mm. thick and 2 mm. long, which is attached to the substratum by a narrow, appressed fringe of pure white fibers and expands rather abruptly into the pendent broadly cone-shaped cap. Cap when wet blackish brown, thinly white-frosted, becoming nearly glabrous, very thin, lightly sulcate when wet, more distinctly so nearly all over when dry, *not* concentrically wrinkled around the base. Flesh nearly all gelatinous, consisting of: (1) a black pellicle about 10–20μ thick, made up of irregular dark brown perpendicular cells encrusted with black amorphous, very fine particles; (2) a hyaline (dark smoky in bulk) gelatinous layer up to 380μ thick near center, thinning to margin, in a medium sized cap (6 mm.) about 110μ half way to the margin, this layer gradually darkening into (3) the thin, scarcely different, also

gelatinous, brownish zone above the gills, which descends into the gills to form the trama and subhymenium which is very thin and only a little denser and darker than the trama. "Stalk" of essentially the same structure as the cap but much tougher; in a plant 5 mm. wide, stalk about 820μ thick with rough black pellicle up to 40–50μ thick including the asperities, the bulk of the trama pale smoky translucent in thin section with a somewhat darker, denser central column that forms the subhymenial layer when the stalk expands into the cap (Pl. 49, fig. 7).

Gills distant, moderately thick, color of cap except for black margin, longer ones broadly rounded (subtruncate) around the focal point, many short, margins smooth, more or less wavy but not interveined.

Spores (of No. 4160) subelliptic, 2.5–3.6 x 6–8.5μ. Hymenium about 30μ thick. No cystidia.

The entire plant is jet black when dry except for the thin, white, appressed hairs (seen under a lens and disappearing in age) and for a minute grayish brown scurf on the tubercle, which is more or less wrinkled longitudinally without regard to the gills which do not extend onto it. Of all the *Pleurotus* species with dorsal tubercle of attachment, this is by far the most conspicuously and habitually "stalked." The dry plant revives perfectly when moistened.

The plant is evidently nearest *Silvanus*, differing mainly in the more developed tubercle of attachment, the distinctly sulcate cap when dry and absence of the delicate, concentric, rugose wrinkles on the cap, the very poorly defined layer above the gills, and the growth on pine twigs. Before we had found a name for our plant we had thought to call it a variety of *Silvanus*, but from Pilát's treatment of *unguicularis* we feel safe in referring it to that species. Pilát also notes the resemblance to *Silvanus*, and discusses variations which also occur in our form; for example, his figure 85 shows the lower layer of the cap trama as much thicker than in ours but he says that it may at other times be thinner than the paler upper layer. He gives the substratum as either on foliose wood (usually) or on conifers (rarely). Ours has been found only on pine and is probably a slightly different form from the one he has chosen to illustrate. The species has not before been reported from America.

Illustrations: Fries. Icones Hymen., pl. 89, fig. 4. The color in this and in the following illustration is too pale to agree with the authors' descriptions.
Gillet. Champ. Fr. Hymén., pl. 240 (535), fig. 2.
Pilát. Atl. Champ. Eur. **2**: Pl. 22 and Fig. 22, 84, 85, 86.
North Carolina. Chapel Hill. No. 4160. On bark of fallen pine twigs, Feb. 21, 1920. No. 13547. On bark of fallen twigs of *Pinus taeda*, Jan. 12, 1944. Spores 3–3.7 x 7.4–8.5 μ.

Pleurotus cyphellaeformis Berk. Mag. Zool. Bot. **1**: pl. 15, fig. 3; Outl. Brit. Fungol., p. 138. 1860.
P. campanulatus Peck. Rept. N. Y. St. Mus. **44**: 131 (19). 1891.
Resupinatus campanulatus (Peck) Murrill. N. Amer. Fl. **9**: 241. 1915.

Plate 50, figs. 1, 2

We have not yet found this interesting little species and do not know if it occurs in the south, though it is certainly to be expected. Murrill says "Re-

ported from South Carolina by Ravenel, but the American specimens do not seem to correspond with the types at Kew." He enters it as doubtfully American, not recognizing *P. campanulatus* as the same. Aside from Peck's type locality in New York State, it seems to have been reported in the United States only once since that time. Dr. A. H. Smith (Pap. Mich. Acad. Sci. **19:** 214, 1934; Ann. Mycol. **32:** 482, 1934) finds it in good quantity at Ann Arbor, Michigan, growing on *Solanum Dulcamara*, and later also on *Sambucus*. It seems to occur most often on dead stems of perennial herbs but at times even on trees (mulberry, type of *campanulatus*). Our figures were drawn by us from a slide kindly lent us by Dr. Smith and prepared by him from the type collection of *campanulatus* in Albany.

For a description of this species (as *cyphellaeformis*) see Smith, as above cited.

Illustrations: Berkeley. Mag. Zool. Bot. **1:** pl. 15, fig. 3.
Cooke. Ill. Brit. Fungi, pl. 244, B.
Pilat: Atl. Champ. Eur. **2:** pl. 21, figs. 2, 3, 6, and Fig. 88 (copied without color from Berkeley).
Smith. Ann. Mycol. **32:** pl. 10, fig. 2.

Pleurotus Rhacodium B. & C. Ann. Mag. Nat. Hist. 3rd ser. **4:** 1859.
(Cent. N. Amer. Fungi, No. 68)

Plate 49, figs. 9–13

Gregarious in small or moderate numbers but never crowded, 3–5.5 mm. wide, centrally to laterally attached, cupulate or conchate, surface on basal half or two thirds covered with a thick strigose to spongy dark brown or black disk of sharply defined limits, the marginal part minutely granular, faintly glaucous, drab brown with a faint flesh tint (about hair brown, Ridg.) and faintly striatulate both when wet and when dry; hairs of the disk about 90–300μ long, usually more or less agglutinated or so matted as to form a sponge; margin even, thick. Flesh made up as follows: (1) a black crust under the disk hairs (wherever it can be distinguished from the agglutinated bases of the dense hairs) about 14–30μ thick, not continuous beyond the disk but consisting of discrete irregular particles of amorphous material; (2) gelatinous layer brown, hyaline, about 370μ thick near center, rapidly thinning to margin, about 135μ thick half way to margin; (3) black-brown layer above gills about 75μ thick, descending into the gills except for a very narrow, somewhat paler layer (like the jelly layer but darker) which runs down the center of the gills, where in thin section it can be seen to be about 30μ thick, the blackish flesh together with the hymenial surface layer making up about the same thickness. Hymenium so dark as not to be distinguishable from the black flesh except in a very thin section.

Gills color of cap, about $\frac{1}{2}$ mm. wide, rather thin, subdistant, of three or four lengths, all truncate at inner end, the long ones, about 9–10, ending abruptly in center around a *glabrous disk*, margin finely granular but not whitish either when wet or when dry, width of gill nearly same throughout except for marginal end.

Spores (of No. 8950a) white, spherical 4.2–5.4(5.8)μ. Hymenium about 15μ thick, nearly black except in thin section. No cystidia.

Distinguished by small size, cupulate habit, faintly striatulate cap both when wet and dry, uniform drab-brown color of gills and cap except for the brown (blackish when wet or old) central, well-defined, strigose-spongy central disk,

the small round spores, and growth on foliose wood or bark. It revives perfectly when wet.

A very small form, up to 2 mm. when dry, occurring in large numbers on *Vitis* (Auburn, Ala., see below) might be called a variety, but spores and appearance are the same as others and the black, sharply defined disk is very conspicuous.

Pilát considers this as only a form of *applicatus*, but as we have it the differences are obvious:—the abrupt spongy disk, blackish or dark brown rather than whitish, and the different internal structure with the jelly layer descending to make the central trama of the gills are striking differences. Moreover *Rhacodium* never reaches the larger sizes or occurs in such numbers as is habitual with *applicatus*.

Illustrations: Lange. Stud. Agarics of Denmark, **6**: pt. 8: pl. 1, fig. 18a–b.

North Carolina. Highlands. No. 8950a. On a decorticated branch of *Kalmia latifolia*, Oct. 5, 1931. J. N. Couch, coll.

The following collections determined as *P. niger* are this species.

In the New York Botanical Garden:

Alabama. Auburn. On corticated *Vitis* branch, Jan. 16, 1897. Earle and Baker. A very small form.

Delaware. Newark. On rotting wood of *Fraxinus*, Oct. 3, 1892. Ellis Coll. No. 2000, *ex* herb. A. Commons.

New Jersey. Newfield. On bark of *Rhus venenata*, Oct. 1875. Ellis Coll. No. 3041.

In the Peck Herbarium at Albany:

New York. Helderberg Mts., Peck, coll. Also from Greenbush, Peck, coll.

Pleurotus applicatus Fr. Hymen. Eur., p. 180. 1874.
P. atropellitus Peck. Rept. N. Y. St. Mus. **39**: 65. 1886.
Resupinatus applicatus (Batsch) Murr. N. Amer. Fl. **9**: 242. 1915.
Resupinatus atropellitus (Peck) Murr. N. Amer. Fl. **9**: 243. 1915.

Plates 43, 44, and Pl. 50, figs. 6, 7

Cap applanate by an excentric point, usually a little longer than broad and more or less constricted downward, or if vertically suspended broadly cupulate, very variable in size, 2–15 x 2–18 mm.; surface at and near base covered with long, strigose, spongy, nearly white to light brown fibers up to 750μ long, which may extend conspicuously to beyond the middle, fading rather abruptly to the subglabrous, fibrous looking or granular margin which is delicately striatulate; color when wet dark (blackish) brown, the margin paler, the tomentum when wet not showing its color. In large plants the margin may be distinctly and more or less deeply lobed (Pl. 44). Flesh composed of: (1) a very thin, more compact, nearly black surface layer about 20–50μ thick or even thinner, in which are embedded colorless crystals and many dark amorphous particles, and giving rise to the fibers above mentioned; (2) a nearly hyaline gelatinous layer, thickest at base, thinning to margin, in large caps about 350–400μ thick half way to margin, in smaller ones about 165–275μ thick; (3) a dense black layer next the gills 55–90μ thick, not counting the very pale hymenium which is about 20μ thick and covers the spaces between the gills. This black layer descends into the gills to make the trama in strong contrast to the pale hymenium, and very different from some other species here treated in which the translucent jelly layer descends into the gills to make the middle layer of the trama.

Gills thin, close or in small plants moderately distant, narrow, about ½–1 mm. broad, brownish drab (almost exactly drab of Ridg.), the margins covered with a thick crust (about 20–26μ) of large crystals which make them a little paler when fresh and grayish white when dry.

Spores (of No. 13546) white, smooth, subspherical, 4–5 x 5–6.5(7)μ. Hymenium about 18–25μ thick. Basidia 5.5–6.5μ thick, 4-spored. Cystidia lacking.

This is a striking species. It occurs in very extensive colonies, up to many hundreds or even thousands, on bark of fallen branches or logs of deciduous wood, at times so crowded as to make a continuous pattern like tiles. It varies greatly in both size and appearance. When projecting horizontally from a vertical base and not too much water-logged, the species is strikingly marked by the whitish pad of spongy tomentum covering the basal half or third of the cap, in strong contrast to the dark brown distal part. In plants hanging down like shallow cups from an excentric or nearly central attachment, the hairs on the cap surface are greatly reduced and found only near the base, and the cap is in most cases whitish, a section showing this lack of color due to the absence of the dark particles so abundant in most of the surface of the shelving plants, the clear crystals being still abundant.

In establishing his *P. atropellitus*, Peck based his conclusion on differences which do not persist when a number of ample collections are examined. The larger plants of his species surpass the measurements given in any of the numerous, inadequate, and contradictory descriptions of *applicatus*, but even his largest plants are considerably smaller than the larger sizes found by us and shown in our figures. These are from an extremely robust collection on thick bark from logs 6–10 inches in diameter. The largest specimens grew horizontally from the cracked edges of loosened bark and tend to be broadly spatulate, and these plants are the ones which are frequently lobed on the margin. Those on the inside of the bark, which are far more numerous and shallowly cup-shaped, decrease rapidly in size from the edges of the bark until the usual dimensions of *applicatus* are reached. The number of individuals evidently of the same colony on a log 8–10 feet long and 7 inches in diameter is immense, running into many thousands.

Atkinson and Hard say the gills are thick and distant but their photographs, especially that of the former, show them clearly as what we would call rather close and thin.

We have examined a number of collections of *atropellitus* from Peck's herbarium in Albany, including the type from Fort Edward. All look alike and are easily recognized as the same as ours. By some means Peck evidently made a mistake in the measurements of the spores, which are too long as he gives them (4–5 x 7.5–8.9μ, translated into our scale). Those from the Maryland, Otsego County, collection, mentioned in the original description, are just like ours, subspherical, 4–4.8 x 4.8–5.5(6)μ. Spores from a collection from West Albany by S. H. Burnham (New York Botanical Garden Herb.) determined by E. C. Howe, who collected the type, are also the same, 3.8–4.5 x 4.2–5.6μ. A section

of a plant from this collection is just like our figure 6 of No. 13546. In Peck's herbarium there are also several collections labelled *applicatus*, two of them collected by himself, which are the same as his *atropellitus*.

We can find no report of the occurrence of *atropellitus* in the south except by Hesler (Journ. Tenn. Acad. Sci. **12**: 251. 1937), but on seeing these specimens through the kindness of Dr. Hesler we find them to be what we are calling (1, from Mt. Leconte) *striatulus* and (2, from Knoxville) *Silvanus*. However, the Tennessee record can stand, as of two collections later sent by Dr. Hesler one was *P. atropellitus* (No. 9649, as *P. niger*, see below).

Pleurotus applicatus and *P. striatulus*, as described by Fries, have been badly confused. The most recent and most detailed treatment of this group of *Pleurotus* is by Pilát, and he comes to the conclusion after much examination of European herbaria that the two species at least as interpreted by Fries should be considered the same, and with them he places a large number of synonyms. As types of neither of these species can now be determined upon, one has to use his own judgment in making a decision. Since Fries's description and *good figure* of *striatulus* agree well with what we have been calling *striatulus*, and as Persoon's usage is evidently the same (Syn. Fung., p. 485), we believe it is best to continue using this name. Bresadola's interpretation is different. He treats as *applicatus* what we call *striatulus*, as shown by plants determined by him from Bavaria now in the New York Botanical Garden (spores globose, 3.8–4.2μ, by our measurements). See also his Iconographia Mycologica, pl. 296, fig. 1.

Plants distributed by the Farlow Herbarium (No. 345) as *applicatus* are also our *striatulus*. Both of these last named examples as well as all of Peck's and ours grew on rotting decorticated coniferous wood, and are very different from the plant on deciduous bark and wood interpreted as *applicatus* by Patouillard, Ravenel, Ellis, Underwood, Atkinson, Peck, Hard, Murrill, and ourselves. However, another plant distributed by Farlow (Ellis Coll. No. 3048 at New York Botanical Garden) is apparently on oak and looks like our *applicatus*. Rea treats as *applicatus* a still different plant with elliptic spores which Pilát thinks is *P. Silvanus* Sacc.

Illustrations: Atkinson. Stud. Amer. Fungi, fig. 111 (114 of 2nd ed.).
Batsch. Elen. Fung., pl. 24, fig. 125.
Hard. Mushrooms, p. 162, fig. 125.
Patouillard. Tab. Anal. No. 519.
Pilát. Atl. Champ. Eur. **2**: pls. 18, 19 and Figs. 20, 79–81.
Sowerby. Engl. Fungi, pl. 301.

North Carolina. Chapel Hill. No. 3879. Closely gregarious in large numbers on the inner side of loosened oak bark, Dec. 13, 1919. Spores subspherical, 3.8–4.2 x 4–4.8 μ. No. 13538. On rotting, decorticated oak stump, Dec. 21, 1943. Spores (print) spherical, 3.7–4 μ. No. 13546. On loose elm bark on log about 7 inches in diameter, Jan. 12, 1944. No. 13552. On loose rotting bark on logs of deciduous trees, Jan. 19, 1944.

Tennessee. Oliver Springs. On fallen limb, Oct. 25, 1936. Hesler, No. 9649, as *P. niger*).

Alabama. Auburn. On *Vitis* bark, Jan. 1896, L. M. Underwood, coll. (N. Y. B. G. Herb., as *applicatus*). Very small plants but otherwise typical.

New York. Otsego County. Peck, coll. (Peck Herb. at Albany, as *atropellitus*)
West Albany. S. H. Burnham, coll. (N. Y. B. G. Herb., as *atropellitus*.

Connecticut. Darien. Smith E. Jelliffe. coll. (N. Y. B. G. Herb., as *atropellitus*).

Other collections seen (N. Y. Bot. Gard. Herb.) but not represented in our herbarium are:
South Carolina. Aiken. Ravenel, Fungi Amer. Exs. No. 409.
New Jersey. Newfield. Ellis and Everhart, Fungi Columb. No. 1564.
Pennsylvania. Lemonte. Orton and Rhodes, March 19, 1915.
Indiana. Putnam County. L. M. Underwood, Dec. 1894.
Ellis, North Amer. Fungi, No. 102 (no other data).

Pleurotus violaceo-fulvus (Batsch) Pilát. Atl. Champ. Eur. **2**: 73. 1935.
Agaricus violaceo-fulvens Batsch. Elench. Fung., p. 95. 1783.
Panus violaceo-fulvus Fr. Systema Myc. **1**: 276. 1821.
Panus Delastrei Mont. Syll. Crypt., p. 149. 1856.
Panus salicinus Peck. Rept. N. Y. St. Mus. **24**: 77. 1872.
Resupinatus violaceofulvens (Batsch) Murr. N. Amer. Fl. **9**: 241. 1915.

Plate 52, figs. 1–5

Excentrically attached by a short or nearly obsolete plug, reflexed or pendent, convex-expanded, up to 15 mm. wide, the uneven margin very thin; surface toward the base and attachment plug densely whitish spongy-tomentose to strigose, thinning toward margin to a delicate crusty puberulence, hygrophanous, when wet pinkish brown with a light violet tint especially toward the margin. Flesh composed of: (1) an upper dense gelatinous, pale dull yellow layer about 60–75μ thick, the upper part of which is blackened by the inclusion of many particles of various sizes (calcium oxalate, Malkovský) and supports the hairs, which are up to 120μ long; and (2) a more fleshy, nearly white layer about 135–150μ thick half way to the margin.

Gills rather broad, some up to 1.5 mm. wide, subdistant, ventricose, tawny brown (about caramel color) with a tint of violet, margins even; hymenium dark brown in section, much darker than the trama which is continuous in color and texture with the flesh of the cap.

Spores (according to Murrill) hyaline, cylindric, somewhat curved, smooth, 2–3 x 8–11μ. Cystidia lacking.

Thanks to the kindness of Dr. House, we have studied the type plants of *Panus salicinus* Peck, and have also seen a collection from Piscataquis County, Maine (Murrill, coll., as *Resupinatus violaceofulvens*), apparently on birch bark. From none of these nor from the type could we get spores that certainly belong. Murrill reports this from North Carolina, but we have not yet found it and have seen no collection from the south.

Pilát treats two forms of this species: the typical on coniferous wood; the other, forma *Delastrei* (Mont.) [*Panus Delastrei* Mont.] on foliose wood. There is very little difference between these, the only difference we can see being a slight one in the intensity of the violet color, and as they are described as showing considerable variation in color, this does not seem to amount to much. In both the Peck and Murrill collections mentioned above, when rewet from the dry state there is very little tint of violet, so little in fact that unless attention was called to it by the name and some descriptions it would not be noticed. However, after standing in a damp dish for a day or so the purple color becomes more evident in all the parts, and the margins of the gills, seen under a lens, have become perceptibly darker than the sides and with a more purple tint. It

was also noted that the flesh at and near the base of the attachment plug is a dull purplish lead color. Montagne's plant is treated fully by Malkovský (Ann. Mycol. **30**: 55. 1932) as forma *Delastrei* (Mont.) Malkovský. As this form and the American one grow on bark of deciduous trees and as Malkovský's photographs to all appearances exactly represent our American plants, it would seem reasonable to call them the same. However, a difficulty appears in the structure of the cap flesh. In Peck's types there is a dense yellowish layer just under the blackish crust which, as shown in a good section, is easily distinct from the nearly white, less gelatinous flesh below. In the yellowish layer the individual threads can scarcely be distinguished even under the high powers, while in the main flesh the outline of each thread is plainly visible, with the walls so thick as to leave the lumen represented only by a line. The fibers themselves of this tissue are pressed close together to make a solid tissue, which does not look at all like the jelly of a typical gelatinous *Pleurotus*. Malkovský's figure of a section does not show the yellow layer.

The dried plants when rewet do not fully regain their form, the margins remaining broadly incurved and somewhat crumpled.

Illustrations: Batsch. Elen. Fung., pl. 9, fig. 39.
Boudier. Icon. Myc. **1**: pl. 82.
Nees von Esenbeck. System d. Pilze und Schw., pl. 22, fig. 180.
Quélet. Champ. Vosges **1**: pl. 14, fig. 2.
Ricken. Blatterpilze, pl. 26, fig. 5.
Malkovský. Ann. Mycol. **30**: 56–61, figs. 18–23.
Pilát. Atl. Champ. Eur. **2**: fig. 24 (spores) and pl. 25.
New York. Albany County. On *Salix sericea*. C. H. Peck. *Type* of *P. salicinus*.
Maine. Piscataquis County. Duck Point Camp, apparently on birch bark. W. A. Murrill.

Pleurotus carolinus n. sp.

Plate 50, figs. 3–5

Amply gregarious on bark of living cedar; very small, 2–3.5(4) mm. broad, centrally or subcentrally attached, cupulate, blackish brown when wet, light gray when dry, from the dense, white, very short, granular-looking tomentum, *not at all striate* either when wet or when dry, the base of larger plants obviously attached with delicate white filaments. Flesh about 300μ thick near base, thinning to margin, about 240μ half way to margin, composed of: (1) an outer membrane of brownish filaments which is about 15μ thick, including large and small crystals and bearing the delicate hairs up to 270μ long in center, fading to a mere pulverulence distally, this layer being fundamentally a tough, translucent jelly but made more or less opaque by the crystals; (2) a hyaline gelatinous layer about 165μ thick, its filaments running perpendicularly; (3) an opaque, dark, dense layer about 60μ thick which runs down into the gills to form their trama.

Gills broad, about 400μ, rather close, very thin, many short, when wet color of cap, when dry clear brown with conspicuously white, granular margins.

Spores (of No. 4016) subspherical, smooth, 3.7–4.1 x 4–4.5μ. Hymenium about 15μ thick. Cystidia lacking.

Distinguished by small size, cupulate habit, margin not striate or sulcate, blackish color when damp, grayish white when dry, granular-tomentose surface,

white granular margins of gills, small round spores, and growth on cedar bark. When dry the larger caps are about 1.75 mm. broad. The species is clearly related to *P. applicatus*, from which it differs in much smaller size, thinner flesh, absence of long strigose hairs on cap center, and in growth on cedar.

North Carolina. Chapel Hill. No. 4016. On bark of living cedar, Jan. 24, 1920.

Pleurotus stratosus Atk. Journ. Mycol. **8**: 116. 1902.

Panus angustatus Berk. Journ. Bot. and Kew Misc. **6**: 318. 1847.

(Not *Panus angustatus* Berk. in Cooke. Handbook Aus. Fungi, p. 98. 1892.

Not *Pleurotus angustatus* Berk. & Br. Journ. Linn. Soc. Bot. **11**: 528. 1871).

Geopetalum angustatum (Berk.) Murr. N. Amer. Fl. **9**: 300. 1916.

Plate 50, figs. 8–11

Clustered and at times slightly imbricated, laterally attached by a narrowed base but the cap margins extending on each side also attached to the wood, flabellate or petaloid or broadly shell-shaped, dull white to pale tawny, convex, about 1.5–3(4) cm. long, 1.5–4 cm. broad, soft, tough, thin, smooth, not striate, surface nearly glabrous on the distal half, gradually more tomentose toward the densely spongy-tomentose base. Flesh composed as follows: (1) a surface skin about 20μ thick at or beyond the middle, much thicker toward base, dark, with threads close and running horizontally, this layer bearing the white tomentum which toward the base forms a woven mat like cotton wool about 300μ thick at most, through which tufted groups of hairs protrude; (2) gelatinous layer about 60–123μ thick (narrowed behind, thickest at or beyond the middle), hyaline, threads forming a tangled mass with no parallel arrangement; (3) lower layer dense, opaque, about 150μ thick near margin, increasing to 800μ near base.

Gills radiating from near the spongy-tomentose, narrowed base, whitish to dull yellowish, crowded, very narrow, about 1–1.5 mm., margins fimbriated like the edge of a rug with hairs up to 74μ long intermingled with the cystidia which are entirely included by them.

Spores (of No. 1823) nearly spherical, smooth, 3.2–3.7 x 3.7–4.5μ (counting mucro). Hymenium 25μ thick; cystidia over all parts, very thick-walled, the lumen in some entirely closed, largely included, only the point (about 8–15μ) protruding, some lightly encrusted, others not at all so, marginal ones smaller, 9.3–11 x 37–50μ, lateral ones about 15–20 x 50–60μ.

The plants revive rather well when resoaked. It seems to us that this species comes easily within the *Pleurotus* group with a gelatinous layer in the flesh. This resemblance is also accentuated by the presence of conspicuous cystidia which are almost identical with those which characterize several species of this group. Atkinson's description differs from ours in some slight respects, for instance, he says the lower compact layer of the flesh makes up about half the thickness of the pileus. In our plants it makes up considerably more than half except near the margin, but this may be due to the fact that our measurements were made from resoaked material and the gelatinous layer may not have revived to its original thickness.

Murrill and Kauffman both consider this species a synonym of *Panus angustatus* Berk., as described in 1847. We think the plant should be treated as a *Pleurotus*, but cannot use the combination *Pleurotus angustatus* as that name was used by Berkeley and Broome for quite a different plant from Ceylon. This leaves Atkinson's specific name the prior one if we are to use the generic name *Pleurotus*.

The species has been reported from North Carolina (Curtis, as *Panus*) but seems to be rare here. It has a wide range in eastern United States but is not known in Europe. It seems not have been illustrated. Peck (Rept. N. Y. St. Mus. **39:** 64) treats it as *Pleurotus petaloides* Fr.

North Carolina. Chapel Hill. No. 1823. On a rotting stump in Battle Park, Sept. 12, 1915.

Pleurotus mastrucatus Fr. Syst. Myc. **1:** 190. 1821.

Plate 45 and Pl. 51, figs. 1–3

Plants horizontally shelving, often imbricated; cap up to 10.5 cm. broad, sessile by a small area, the lateral lobes also often clinging to the wood; surface dry, densely covered with a whitish or drab, rather frosty-looking mat of soft tomentum, about 1 mm. thick in center, thinning toward the margin and there allowing the mouse gray color of the upper flesh to be visible; this tomentum at times more or less drawn together into scurfy points, particularly near the margin, collapsing and wearing away by degrees, leaving a mangy appearance; margin more or less irregular and lobed and involute at all ages; when young and moist the entire cap dark smoky drab (about hair drab of Ridg.) or darker, due to the thinness of the tomentum at this stage, allowing the dark flesh to show through it. Flesh sharply divided into an upper layer of deep drab or nearly black, firmly gelatinous, translucent substance about 0.5–1 mm. thick over the whole cap, and a lower whitish non-gelatinous layer, thinner than the upper near the margin and thicker, about 2.5 mm., near the base; taste distinctly farinaceous, odor none. On drying the upper layer shrinks down to a thin but still distinctly visible dark membrane.

Gills crowded, radiating from near the point of attachment, narrow at both ends, about 3–4 mm. wide in center; color a pallid white or faint creamy drab when young, changing to a rather light brownish-yellow at maturity, unchanged in drying. There is no distinct stem, but the gills do not extend quite to the substratum, there being a smooth area intervening that is densely tomentose or at times merely chalky-looking. The gills terminate rather abruptly or fade away into narrow lines.

Spores (of No. 617) short-elliptic, smooth, 5.6–7 x 6.5–8.5(9)μ. Cystidia pointed, 66–90μ long, more or less encrusted.

Illustrations: Cooke. Ill. Brit. Fungi, pl. 243 (above).
Sowerby. Engl. Fungi, pl. 99.

North Carolina. Chapel Hill. No. 617. In rotting place in a beech tree at Meeting of Waters. No. 2842. From decaying oak log in woods, Oct. 1, 1917. Spores 5.5–6.5 x 7–8.5 μ. No. 4678. On a rotten hickory log, Oct. 18, 1920. Spores 5.5–6.5 x 6.8–8 μ. Large plants with the tomentum largely worn away.

Pleurotus atrocaeruleus Fr. var. **griseus** Peck. Bull. N. Y. St. Mus. **44:** 35 (147). 1891.

P. griseus Peck. Bull. N. Y. St. Mus. **131: 25.** 1909.

Resupinatus griseus (Peck) Murrill. N. Amer. Fl. **9:** 240. 1915.

Plate 41 (below), Pl. 46 (below), and Pl. 51, figs. 4–11

Sessile from a rounded, elevated center, applanate, at times imbricate, varying greatly in size, as 2–3 x 1.5–2 cm. or rarely up to 5–6.5 x 3.5–4 cm., always with broad, rounded lobes or divided nearly to the base; surface buffy gray to dark blackish brown, villous with agglutinated hairs up to 400–450μ long toward base, becoming delicately tomentose toward the nearly smooth, paler margin, which in small plants is finely striatulate when fresh. Flesh strongly hygrophanous, reviving when wet, tough, elastic, composed of three layers: in a medium sized cap, (1) an upper dark (pale yellowish in thin section) pellicle 10–12μ thick which bears the hairs; (2) a hyaline gelatinous layer about 250–400μ thick; (3) a transition zone, dark brown above to black below, about 100μ thick (upper limit fading into the hyaline jelly and therefore indefinite); and (4) a dense white opaque layer above the gills, varying from practically nothing at the margin to about 300μ thick near the base. In the large plants (No. 1631) the jelly layer ½–1 mm. thick, white basal layer about 3 mm. thick at very base.

Gills pallid to creamy white, close, narrow, hardly 1 mm. (up to 3 mm. in No. 1631), many short, the longer ones converging at very base, some of the longer with irregularly serrate margins; sides and margin, also space between the gills, set with numerous very characteristic cystidia which are acuminate, very thick-walled, more or less granular-encrusted, deeply inserted in the translucent hymenium, the tips exserted only 11–25μ on the sides, about 9.5μ on the edges of the gills, the side ones about 12.5–15 x 55–63μ, the marginal ones about 11 x 33μ.

Spores (of No. 13296) pure white (fine prints), broadly elliptical with a flattened side, 3.5–3.8(4) x 6.3–7.7μ (a few smaller).

When dried the margin is strongly incurved and the gills are buffy yellow to ochraceous tawny; when rewet they revive partially but not fully.

Smith has described a small form from Michigan on *Solanum* and *Sambucus*, some as small as 3 mm. (3–20 mm.), with characters the same as usual (Ann. Mycol. **32:** 481. 1934). The largest specimens we have seen, aside from our No. 1631, are from E. A. Burt, now in the New York Botanical Garden (Ellis Coll.), labelled "*Pleurotus atrocaeruleus* Fr. var. *griseus* Peck, 44 Rept. p. 35[147]. Determination of material confirmed by Peck. On dead standing trunks, Middlebury, Vermont, Aug. 7, 1896." They are up to 2 cm. in the dry state and thick in proportion; microscopic details the same as in others.

We have examined Peck's types in Albany on *Magnolia acuminata* and find that they are just like our No. 13296, with spores 3.2–3.8 x 6.6–7.8μ, cystidia 11–16(18)μ thick. In the New York Botanical Garden there is also a collection from Bronxwood Park, growing on a decayed spot in a living trunk of red maple; spores 3.7–4.2 x 7–9μ.

It will be seen from the above description that we have in North Carolina plants of this species that range in size from the usual rather small dimensions to an unusual width of 6.5 cm. (see our photographs). If this large size had any

blue color it would be called *atrocaeruleus* without any question, but we have never seen any blue color in the American plant, and neither has Smith (above cited) or Peck. Murrill indeed does treat *atrocaeruleus* as at times dark blue but this may very well have been done in deference to European descriptions. We think that Smith is right in considering the American plant as only a variety, as first presented by Peck. Our largest plants (No. 1631) and our smallest (No. 13296) show exactly the same spores, cystidia and all other characters the same, allowing for difference in size.

Illustration: Smith. Ann. Mycol. **32:** pl. 10, fig. 1, 1934.
North Carolina. Chapel Hill. No. 1631. On a hickory log, July 23, 1915.
Highlands. No. 13296. On bark of living trunk of *Magnolia Fraseri*, July 20, 1941. Note that the type also occurred on *Magnolia*.

Pleurotus petaloides var. **spathulatus** Fr. Syst. Myc. **1:** 183. 1821.
Geopetalum geogenium Pat. Hymen. Eur., p. 127.

Plate 46 (above) and Pl. 52, figs. 6, 7

Gregarious, often in clusters on grassy or bare soil or, in No. 11044, on charred sawdust. Cap up to 12 cm. broad, usually smaller, irregular, crenated and crumpled and fan- or petal-shaped from the basal lateral stem, the sides often strongly incurved; surface smooth, tan or leather color with a white granular bloom near base. Flesh elastic, brittle; taste very farinaceous, somewhat bitter and with a very disagreeable taste of rancid oil; odor almost none; composed of the following regions: (1) surface pellicle, pale gray-brown, about 20–25μ thick, including the projecting free filaments; (2) gelatinous layer, transparent, hyaline, 215μ thick, threads horizontal; (3) dense yellow-brown layer, about 160μ thick fading rather abruptly into the paler layer below; (4) thick, nearly white main layer about 2 mm. thick in this cap which was about 2 cm. long.

Gills narrow, crowded, strongly decurrent, nearly white, then cream, later creamy brown, the edges fuzzy from the cystidia.

Stem short, continuous with the cap, light pinkish brown with a white bloom, extending into the ground with a distinct root.

Spores (of No. 11044) pure white, smooth, short-elliptic, a few faintly pip-shaped, 3.7–4.4 x 6.5–7.8μ. Cystidia abundant on margins and sides of the gills, thick-walled, yellowish, 13–20(25) x 63–90μ, the tips of some more or less encrusted.

Peck (Rept. **39**) includes both *P. petaloides* and *P. spathulatus* but, as Kauffman suggests, his *petaloides* with minute spores is probably *Panus angustatus* Berk. (see our *stratosus*). In Europe *P. petaloides* as there understood has spores like our present plant, and as Fries founded his var. *spathulatus* of *petaloides* only on the form growing on the ground, we think it best to use this name for our plants. It is very probable that there is no real difference between *P. petaloides* and the variety. By some authors the first is confined to dead wood, the latter to the ground, but Bulliard's original *petaloides* cited by Fries grew on the ground. Schweinitz treats them as the same (Syn. Fung. Amer., p. 148).

Rea is the only recent author we find who mentions the gelatinous layer in the cap of *petaloides*. To the naked eye this layer is hardly notable, but in mag-

nified section it is quite obvious as a thin hyaline layer between the two opaque layers. This tissue is not elastic, but appears just as in other species, a colorless matrix through which the widely separated threads can be seen to run. Lange mentions cystidia on the cap surface but there are none in our plants and we find no one else who mentions such. Lange also says the spores are minutely warty-punctate.

Quélet's plant that he treats (Bull. Soc. Bot. Fr. **26:** 47. 1879) as *Pleurotus geogenius* DC. with a question is certainly our plant, as he mentions particularly the gelatinous layer. Bresadola describes and illustrates (Fungi Trid., p. 46; later again in Icon. Myc. **6:** pl. 292) what he considers *P. geogenius* DC. and says it is different from Quélet's plant above mentioned in that the latter has a gelatinous layer and pruinate-velvety cap. His illustration of *geogenius* shows no gelatinous layer in the flesh. For reference to forms of the species in America (as *P. geogenius*), see Murrill in Mycologia **4:** 3, 1912.

Illustrations: Atkinson. Stud. Amer. Fungi, figs. 109, 110.
Hard. Mushrooms, fig. 120, p. 108 (as *P. petaloides*).
Murrill. Mycologia **4:** pl. 56, fig. 6 (as *P. geogenius*).
Patouillard. Tab. Anal. No. 421 (as *P. petaloides* var. *lobatus*); Hymen. Eur., pl 2, fig. 3 (as *Geopetalum geogenium*).

North Carolina. Chapel Hill. No. 45. In grass on the University campus, Oct. 23, 1911. Spores white, no tint of pink, 4.5 x 7.4–8.3 μ. No. 1693. On soil under cedars on north edge of the arboretum, Sept. 7, 1915. No. 13586. Under shrubs in Arboretum, July 19, 1944.
Chatham County. No. 11044. On charred sawdust, Sept. 17, 1938.

Pleurotus hypnophilus (Berk.) Sacc. Syll. Fung. **5:** 384.

Plate 52, fig. 8

Very thin and delicate, all parts pure white when fresh; cap shelving, shell- to petal-shaped, about 4–7 mm. broad and 4–14 mm. long, laterally sessile, convex or nearly plane, the margins inturned when young, surface uneven, minutely puberulent all over, not striate or faintly so. Flesh homogeneous, membranous, very delicate, not gelatinous, only about 150μ thick half way to margin on reviving after drying; taste farinaceous, odor none.

Gills not crowded, thin, narrow, radiating from and terminating rather abruptly at the point of attachment, white then faintly flesh color towards the base.

Spores (of No. 7156) white, smooth, pip-shaped to subovate, 3–3.7 x 5.5–7.4μ. Cystidia lacking.

We refer this to *P. hypnophilus* with some confidence. It does not seem to have been reported from America, but it fits well enough into European descriptions. The white mycelium climbs a little way up the stems of grasses or moss and forms its little cap about 5–10 mm. from the ground. When dry the cap is dull whitish to tan, the gills dark leather color (about antique brown, Ridg.). When rewet it revives to full size but does not regain perfect form. It is our most delicate species.

Illustrations. Cooke. Ill. Brit. Fungi, pl. 212, fig. C.
Patouillard. Tab. Anal. No. 422.

Persoon. Mycol. Eur. **3**: pl. 24, fig. 5 (as *Agar. variabilis* var *hypnophilus*).

North Carolina. Chapel Hill. No. 2776. On bits of grass near the earth in a shady lawn, July 26, 1917. No. 7156. On grass and moss, same place as above, Sept. 26, 1923.

Pleurotus candidissimus B. & C. Ann. Mag. Nat. Hist. III, **4**: 288. 1859.
Geopetalum candidissimum (B. & C.) Murrill. N. Amer. Fl. **9**: 298. 1916.

Plate 52, fig. 9

Plant pure white; cap up to 5 mm. wide, convex, glabrous, not striate. Flesh homogeneous, not gelatinous, white, very thin, only 118μ, surface nearly smooth, even when magnified by 100.

Stem distinct, lateral, about 1 mm. long, terete, attached at base by a pad of white tomentum.

Gills moderately close, up to $\frac{3}{4}$ mm. wide, white, edges finely fimbriate.

Spores (of No. 5680) white, smooth, spherical, 4.2–6μ. Hymenium 20μ thick; no cystidia.

Our plants agree closely with those of Europe described by Pilát (Atl. Champ. Eur. **2**: 37. 1935). He cites *P. leucochrius* Britz. as a synonym, and *P. haedinus* B. & C. from Cuba as probably the same.

North Carolina. Blowing Rock. No 5680. On decorticated wood of *Rhododendron maximum*, Aug. 22, 1922.

Highlands. No. 10118. On mossy trunk of living maple, July 23, 1935. No. 10125. On mossy bark of living birch, July 24, 1935. Spores 4–6 μ, spherical.

Pleurotus septicus Fr. Syst. Myc. **1**: 192. 1821.
Agaricus pubescens Sow. Engl. Fungi, pl. 321.
Geopetalum septicum (Fr.) Murr. N. Amer. Fl. **9**: 299. 1916.

Plate 52, fig. 10

Appearing first as a little pure white cottony ball which opens up in center to become the cap, which is a shallow cup up to 6 mm. broad, excentrically attached but becoming almost circular; surface very delicately byssoid flocculent, not striate, and often becoming attached to the substratum to a greater or less extent (resupinate), white, later discolored like the gills. Flesh very thin and delicate, little if at all viscid, and with no gelatinous layer.

Stem very short, delicate, terete, soon almost disappearing by the enveloping growth of the cap.

Gills white at first, soon buffy cream color (like the spores), rather thin, not close, about 1 mm. wide, usually broadest and rounded to truncate behind and free or less often adnexed to a little plug which represents all that is visible of the stem; margin tending to become more or less toothed at maturity.

Spores (of No. 13537) creamy yellow (print), smooth, rather narrowly pip-shaped, 2.8–3.5 x 6–7.4μ. No cystidia present.

Our plants agree well with Pilát's description and illustrations, and rather well with Cooke's illustration and Murrill's description. In many cases at maturity there is no visible trace of a stem, but when the cap is developing the stem is often plain enough, though very short. The plants are extremely delicate and the resupinate parts leave a white byssoid print on the bark.

So far we have seen no other report of this species from the southern states. Murrill says "northern United States west to Washington." It is extensively distributed in Europe, and Pilát says it is also reported from South America. For other synonyms see Pilát (Atl. Champ. Eur. **2**: 24).

Illustrations: Cooke. Ill. Brit. Fungi, pl. 259, B.
Patouillard. Tab. Anal. No. 627.
Pilát. Atl. Champ. Eur. **2**: pl. 1. 1935.
Sowerby. Engl. Fungi, pl. 321 (as *Agaricus pubescens*).

North Carolina. Chapel Hill. No. 13537. On corticated fallen branch of a decidous tree (Albizzia?), Dec. 14, 1943. No. 13579. On bark of fallen Albizzia(?) branch, Jan. 27, 1944. Spores just as above, with one side flattened, 2.6–3.6 x 6.5–8(9) μ. No. 13580. On rotting twigs of a deciduous tree (oak?), March 8, 1944. Spores (print on slide) creamy, one side flat, the other rounded, proximal end tapering, 2.6–3.5 x 5.5–7.4 μ.

Pleurotus viticolus Murrill. Bull. Torr. Bot. Club **67**: 235. 1940.

Plate 52, figs. 11, 12

Cap laterally, but soon appearing excentrically, sessile, usually becoming more or less resupinate and attached by very delicate pure white fibers, 2–5(7) mm. broad, white with a faint fawn tint, very delicately lanate (or becoming glabrate) except on the pulverulent margin, faintly or distinctly striate both when fresh and when dry. Flesh very thin, soft, white, homogeneous, not gelatinous.

Gills white, broad, 0.6–0.8 mm., moderately close to subdistant, not veined, creamy buff when dry.

Spores (of No. 5924) white, ovate to pip-shaped with distinct *longitudinal ridges*, 4.2–5.4 x 6–8.2μ. Basidia about 6.5μ thick, 4-spored. Cystidia lacking.

This species has been reported before only from the type collection (Florida), where it occurred on the same substratum as our first collection. The peculiar spores are unique among American species we have seen. We have compared typical plants kindly sent us by Dr. Murrill. Their spores are a little smaller, a difference not surprising in this genus. Murrill does not mention the ridges, which are the same in the type as in our collections.

North Carolina. Smith Island. No. 5924. On dead bark of *Vitis*, Oct. 3, 1922.
Chapel Hill. No. 13542. On hard decorticated dogwood branch, Dec. 27, 1943. Spores 4.2–5 x 5.5–7.5 μ, with longitudinal ridges.
Florida. Arredonda. On a dead grape vine. West and Murrill, type.

Pleurotus tremulus (Schaeff.) Fr. Syst. Myc. **1**: 191. 1821. Hymen. Eur., p. 177. 1874.

Plate 52, fig. 13

This species is evidently rare, and so far as we can find has been reported only a few times in this country (New York, Gerard, Peck Herb.; Pennsylvania, Schweinitz: Tennessee, Hesler; Michigan, Smith; Nova Scotia, Smith and Wehmeyer). Both Schweinitz and Curtis report *P. planus* from North Carolina, and this species is considered by Pilát to be only a form of *acerosus*, which apparently differs from *tremulus* only in its spores. However, their North Carolina plants could hardly be *tremulus*, as Schweinitz says, "common on trunks."

In recent years ample collections of this species have been found in Tennessee by Hesler and reported by him (Journ. Elisha Mitch. Sci. Soc. **49**: 151. 1933), all growing on large mosses. As Hesler published an adequate description, we quote it here as follows.

"Pileus 1–3.5 cm. broad, moist, subviscid in one collection only (No. 3687); fuscous to Chaetura drab (Ridgway) when fresh, cinereous when dry, hygrophanous; submembranaceous; conchate, dimidiate, or reniform, depressed behind and there white floccose-tomentose (under lens), other portions, in some specimens, appressed whitish fibrillose; margin undulate, often lobed and in some crenate-lobed, at first decurved then expanding somewhat, even or substriate. Flesh concolor (moist), pallid (dry), thin, homogeneous, without odor and taste. Gills adnate or decurrent, thick when young (suggesting *Cantharellus*) but thin and typically lamellate at maturity, many short, the shorter ones of about three ranks, subdistant, concolor (moist), paler (dry), sometimes intervenose at the pileus, edge even, longer ones occasionally forked toward margin of pileus. Stipe 4–18 mm. long (commonly 4–8 mm.), up to 5 mm. in diameter, greyish, solid, dilated upwards, villose-strigose, lateral; stipe rarely lacking. Spores somewhat variable in shape, mostly pip-shaped and nearly spherical, or ovate-elliptical, a few pyriform; smooth, white in mass, usually apiculate; size somewhat variable, 6–8.5 x 3.5–7μ (majority 7–7.5 x 5–5.5μ). Basidia clavate, about 22 x 7μ; sterigmata up to 5.5μ long."

Our measurements of spores of the same collection which he figures are 4-5.5 x (5.5) 6-7.4 (8)μ (see our fig. 13).

Hesler mentions in his description that *tremulus* appears to be close to *acerosus* Fr. If the two species are really distinct they have been badly confused, as brought out by Pilát (Atlas Champ. Eur. **2**: 53-54). According to Pilát, the spores are about the only difference, and our measurements of the spores of the Tennessee plants are intermediate between those given by Pilát and by Rea. Lange mentions what he considers a transitional form between *acerosus* and *tremulus* which has spores 6.5-7.5 x 3.5μ.

Illustrations: Cooke. Ill. Brit. Fungi, pl. 242.
Hesler. Journ. Elisha Mitch. Sci. Soc. **49**: pl. 9 (above). 1933.
Hoffman. Bot. Zeit. **18**: pl. 13, fig. 5. 1860.
Loudon. Encyclop., fig. 15933.
Pilát. Atl. Champ. Eur. **2**: pl. 13 and figs 18, 19 (spores).
Schaeffer. Icon. Fung. Bav., pl. 224.

Tennessee. Knox County. L. R. Hesler, coll. Several collections on *Dicranum scoparium* in pine woods, from Nov. 15, 1932, to Jan. 14, 1933.

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EXPLANATION OF PLATES 47–52

PLATE 47

Pleurotus approximans, figs. 1–6.

Fig. 1. Longitudinal section of cap. No. 13541. × 11.

Fig. 2. Cross section of cap with gills, showing layers of flesh and the hymenium with cystidia. (a) Cluster of parasitic threads, probably of an ascomycete or imperfect fungus, invading the gelatinous layer. No. 13551. ×68.

Fig. 3. Bit of these parasitic threads. Highly magnified.

Fig. 4. Cystidia. No. 13551. × 500.

Fig. 5. Cystidia. No. 13541. × 500.

Fig. 6. Spores. No. 4024. × 1620.

Pleurotus elegans, n. sp., figs. 7–12.

Fig. 7. Longitudinal section of cap. No. 13530. × 38.

Fig. 8. Cross section of cap with gills. No. 10355. × 68.

Fig. 9. Cystidia. No. 13530. × 810. These are not numerous and some sections may not show them.

Fig. 10. One cystidium and two sterile cells from edge of gill. No. 10350. × 810.

Fig. 11. Basidium and sterile cells in hymenium. No. 10350. × 810.

Fig. 12. Spores. No. 13530. × 1620.

PLATE 48

Pleurotus niger, figs. 1–6 (1–4 from Philadelphia Academy material; others from Washington)

Fig. 1. Longitudinal section of a bit of cap showing part of a gill and cystidia. × 68.

Fig. 2. Bit of surface crust with some threads projecting. × 810.

Fig. 3. Five cystidia, all from cap surface. × 500. The lower half of these and of all the other cystidia is red-brown.

Figs. 4, 5. Cystidia from sides of gills. × 500.

Fig. 6. Spores. × 1620.

Pleurotus crustosus, fig. 7–9.

Fig. 7. Cross section of a bit of cap and gill showing layers of flesh and hymenium. No. 3896. × 34.

Fig. 8. Cystidia; one on the left from gill margin, others from side of gills. No. 13545. × 500.

Fig. 9. Spores. No. 3896. × 1620.

PLATE 49

Pleurotus striatulus, figs. 1–3.

Fig. 1. Habit sketch of plants in the dry state. No. 10323. × 7. (Alleda Robb Burlage, del.)

Fig. 2. Cross section of bit of cap and gill showing layers of flesh and hymenium. No. 10323. × 68.

Fig. 3. Spores. No. 10323. × 1620.

Pleurotus Silvanus, figs. 4 and 5.

Fig. 4. Cross section of part of cap with gills and hymenium. Ravenel's Fungi Exs. Car. No. 1, as *P. niger*. × 68.

Fig. 5. Spores. No. 13533. × 1620.

Pleurotus unguicularis, figs. 6–8.

Fig. 6. Cross section of part of cap with gills and hymenium. No. 13547. × 68.

Fig. 7. Cross section of stem. No. 13547. × 38.

Fig. 8. Spores. No. 4160. × 1620.

Pleurotus Rhacodium, figs. 9–13.

Fig. 9. Cross section of part of cap with gills and hymenium, cut beyond the basal disk. Ellis Coll. No. 3041, as *P. niger*, New York Bot. Garden. × 68.

Fig. 10. Section of cap showing strigose basal disk. No. 8950a. × 3.

Fig. 11. Bit of disk showing matted, agglutinated fibers. Ellis Coll. No. 3041. × 68.
Fig. 12. Surface view of some crystals in crust outside of disk. Ellis Coll. No. 3041. × 278.
Fig. 13. Spores. No. 8950a. × 1620.

PLATE 50

Pleurotus campanulatus, type (= *P. cyphellaeformis*), figs. 1, 2.
Fig. 1. Longitudinal section of part of cap. Type. × 68.
(From slide prepared by Dr. A. H. Smith)
Fig. 2. Spores. Type. × 1620.
Pleurotus carolinus n. sp. figs. 3–5.
Fig. 3. Longitudinal section of cap and gill (diagram). No. 4016. × 38.
Fig. 4. Cross section of part of cap with gills and hymenium. No. 4016. × 68.
Fig. 5. Spores. No. 4016. × 1620.
Pleurotus applicatus, figs. 6, 7.
Fig. 6. Cross section of part of cap with gills and hymenium. No. 13546. × 68.
Fig. 7. Spores. No. 13546. × 1620.
Pleurotus stratosus, figs. 8–11.
Fig. 8. Cross section of part of cap with gills, hymenium and cystidia. No. 1823. × 68.
Fig. 9. Bit of gill margin. No. 1823. × 120.
Fig. 10. Cystidia. No. 1823. × 500.
Fig. 11. Spores. No. 1823. × 1620.

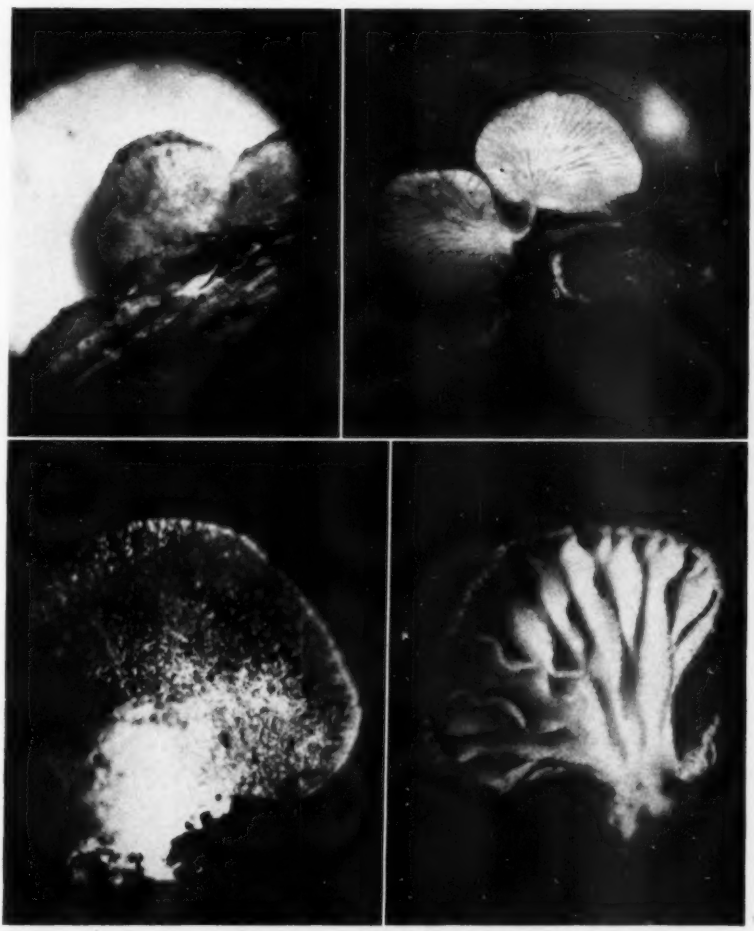
PLATE 51

Pleurotus mastrucatus, figs. 1–3.
Fig. 1. Cross section of part of cap and gills. No. 617. × 8.
Fig. 2. Cystidia. No. 617. × 500.
Fig. 3. Spores. No. 617. × 1620.
Pleurotus atrocoeruleus var. *griseus*, fig. 4–11.
Fig. 4. Cross section of part of cap and gill, showing hymenium and cystidia. No. 13296. × 68.
Fig. 5. Hairs on surface of cap. No. 13296. ×278.
Fig. 6. Cystidia; small one on left from edge of gill. No. 13296. × 500.
Fig. 7. Spores. No. 13296. ×1620.
Fig. 8. Hairs on surface of cap. No. 1631. × 120.
Fig. 9. Cystidia and a few sterile cells; small cystidium on upper left from edge of gill. No. 1631. × 500.
Fig. 10. Spores. No. 1631. × 1620.
Fig. 11. Spores. Type. × 1620.

PLATE 52

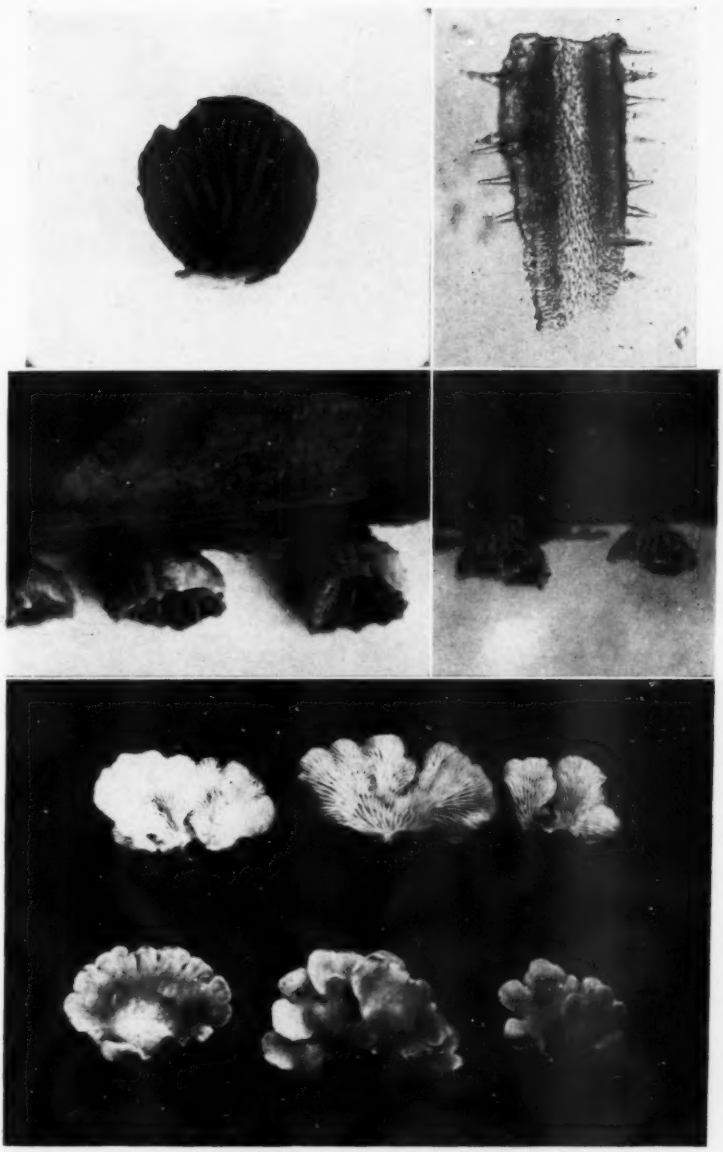
Panus salicinus, type (= *Pleurotus violaceo-fulvus*), figs. 1–5.
Fig. 1. Longitudinal section of cap. × 27.
Fig. 2. Bit of surface crust and short hairs near margin. × 500.
Fig. 3. Cross section of part of cap with gills. × 68.
Fig. 4. Threads of flesh, showing thick walls. Highly magnified.
Fig. 5. Spores. × 1620. These spores were obtained from a mount of the type but were few and may not be authentic.
Pleurotus petaloides var. *spathulatus*, figs. 6, 7.
Fig. 6. Cystidia. No. 11044. × 500.
Fig. 7. Spores. No. 11044. × 1620.
Pleurotus hypnophilus. Fig. 8. Spores. No. 7156. × 1620.
Pleurotus candidissima. Fig. 9. Spores. No. 5680. × 1620.
Pleurotus septicus. Fig. 10. Spores. No. 13537. × 1620.
Pleurotus viticolus. Fig. 11. Spores. No. 5924. × 1620. Fig. 12. Spores of type × 1620.
Pleurotus tremulus. Fig. 13. Spores. Hesler, No. 3397. × 1620.

PLATE 40



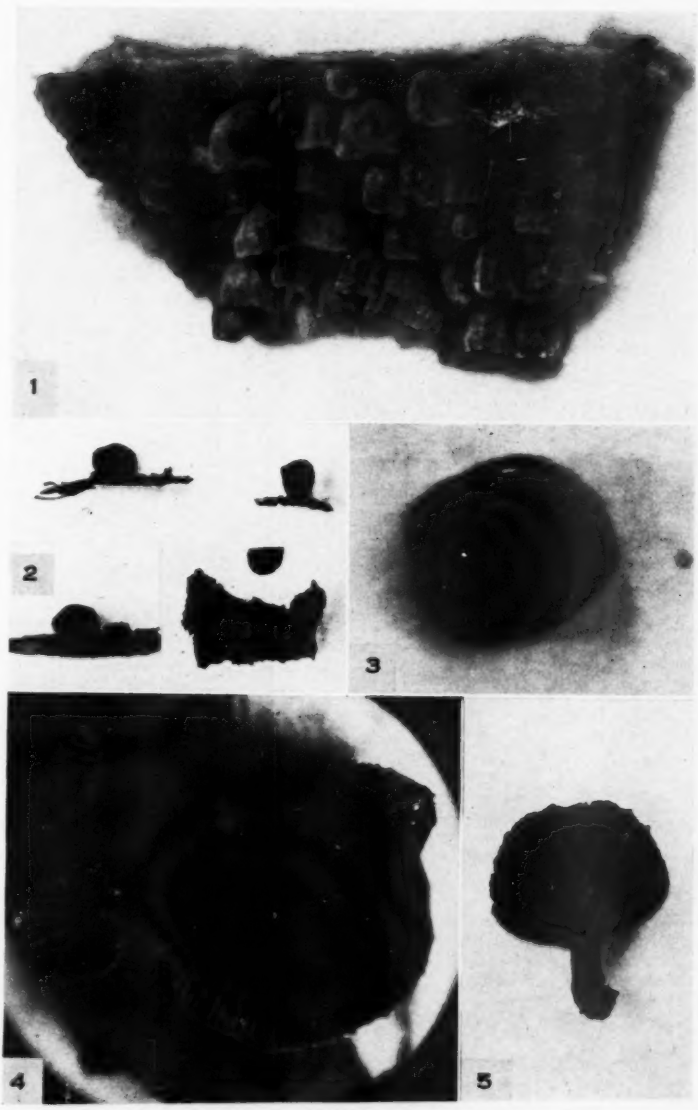
Pleurotus approximans (above). No. 13551. ×2
Pleurotus elegans (below). No. 13530. ×14

PLATE 41



Pleurotus niger (top). Schweinitz Herb., Philadelphia. Left, ×6; right, ×132
Pleurotus crustosus (center). No. 13545. ×ca. 4
Pleurotus atrocoeruleus var. griseus (below). No. 13296. Nat. size

PLATE 42

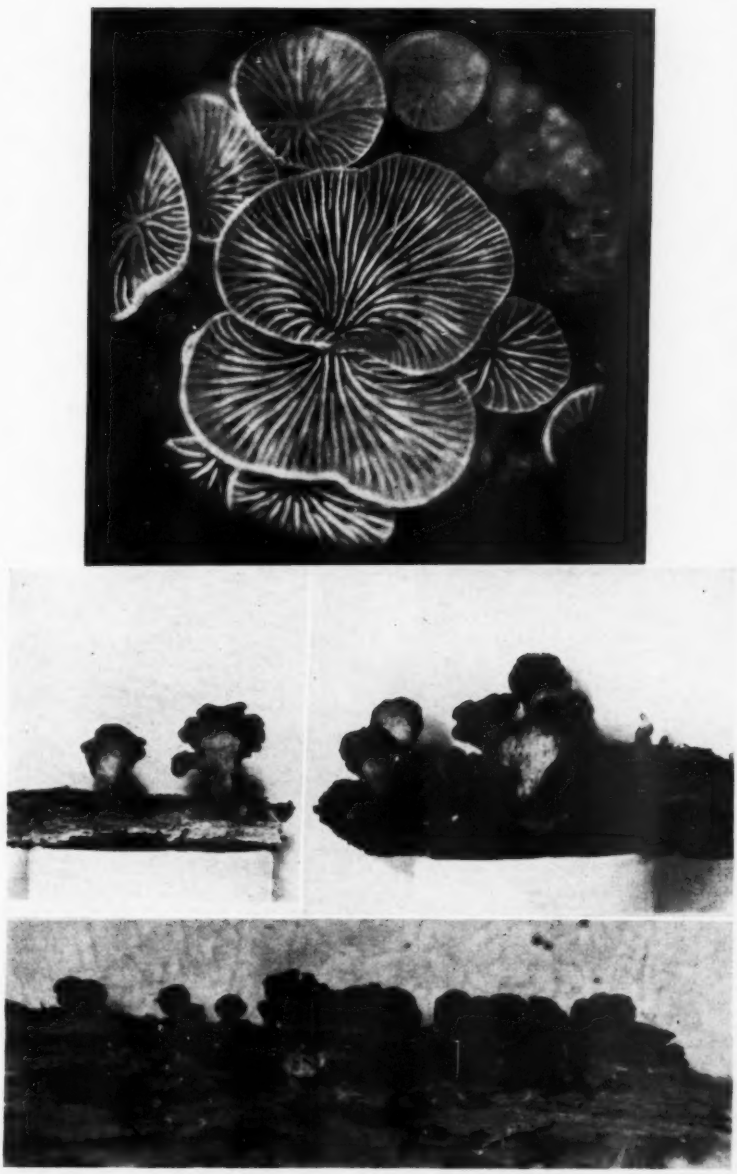


Pleurotus striatulus. Fig. 1, No. 10323. ×7
Pleurotus Silvanus. Fig. 2 & 3, No. 3845. Nat. size and × 7, respectively
Fig. 4, No. 13535. × 7½
Pleurotus unguicularis. Fig. 5, No. 13547. × 7

PLATE 43

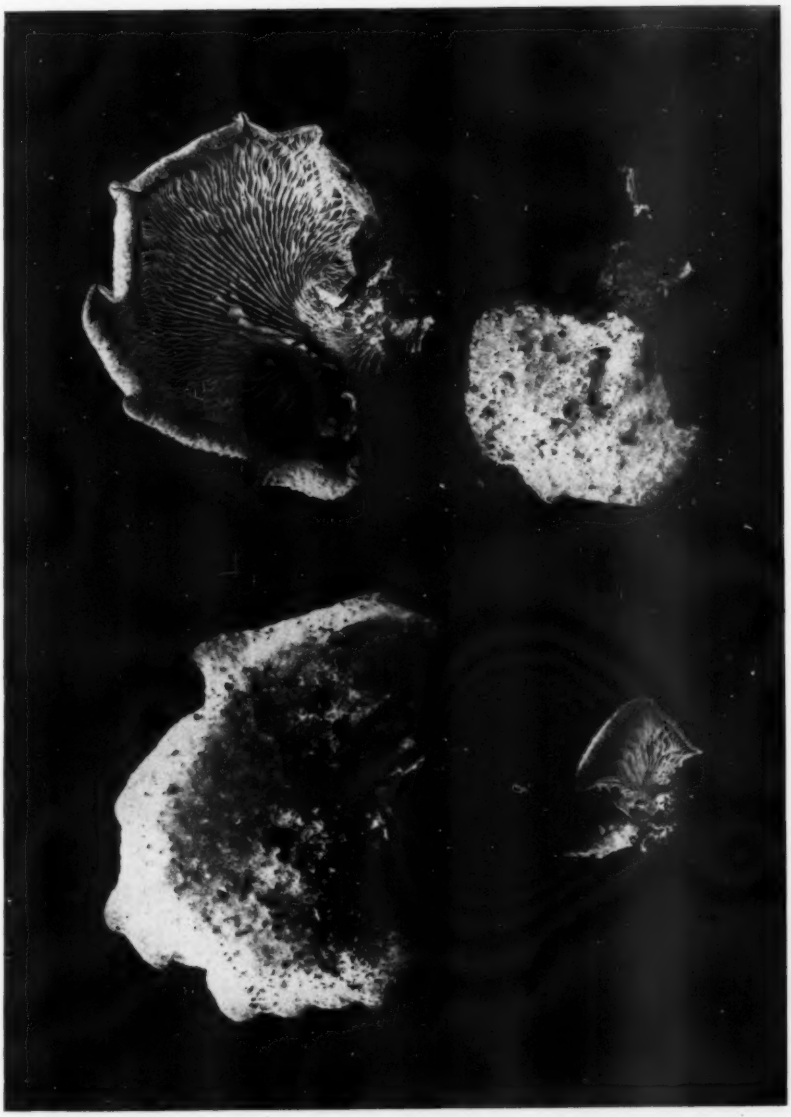
Pleurotus applicatus. No. 3879. Nat. size

PLATE 44



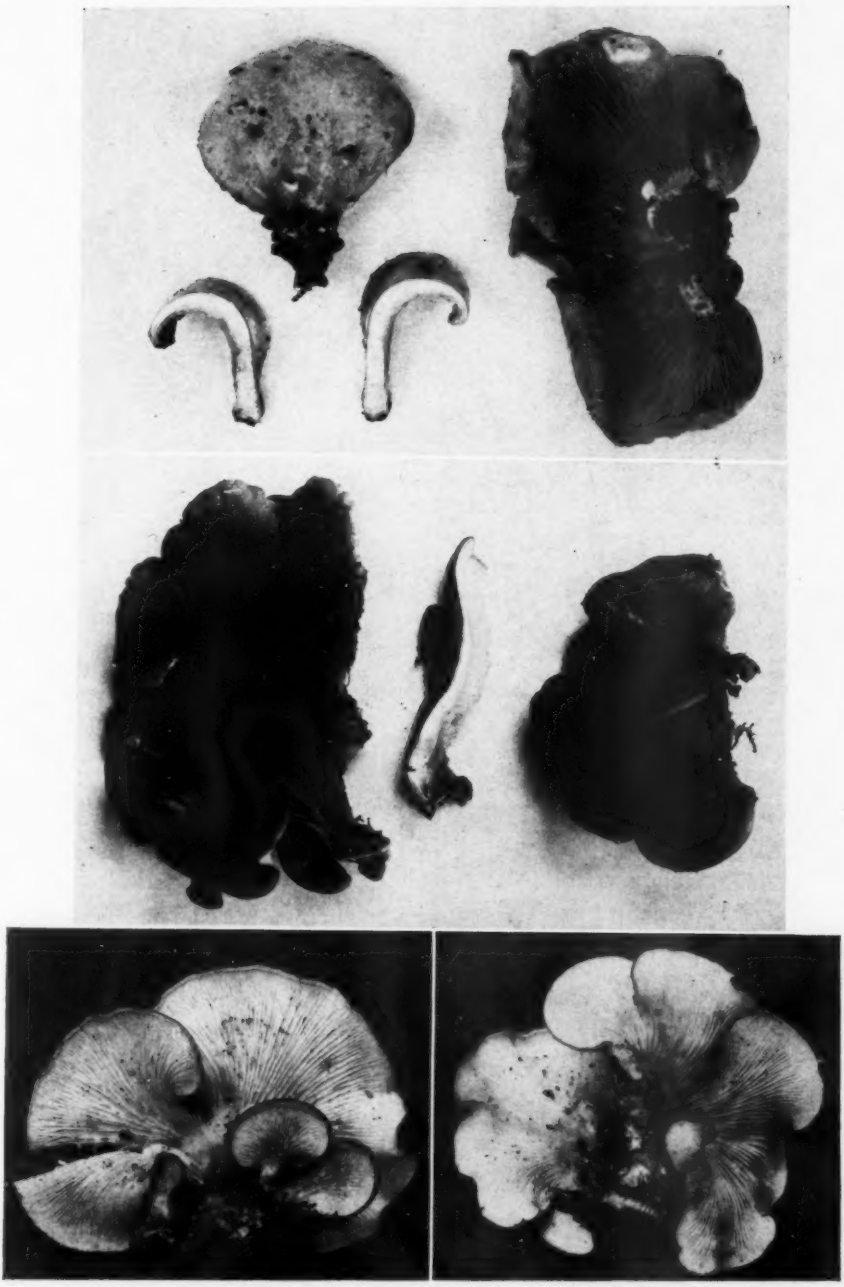
Pleurotus applicatus. No. 13546 (top and bottom). × 7 and nat. size, respectively
No. 13552 (center). Nat. size

PLATE 45



Pleurotus mastrucatus. No. 617. Nat. size

PLATE 46



Pleurotus petalloides var. spathulatus (above). No. 11044. Nat. size
Pleurotus atrocoeruleus var. griseus (center and below). No. 1631. Nat. size

PLATE 47

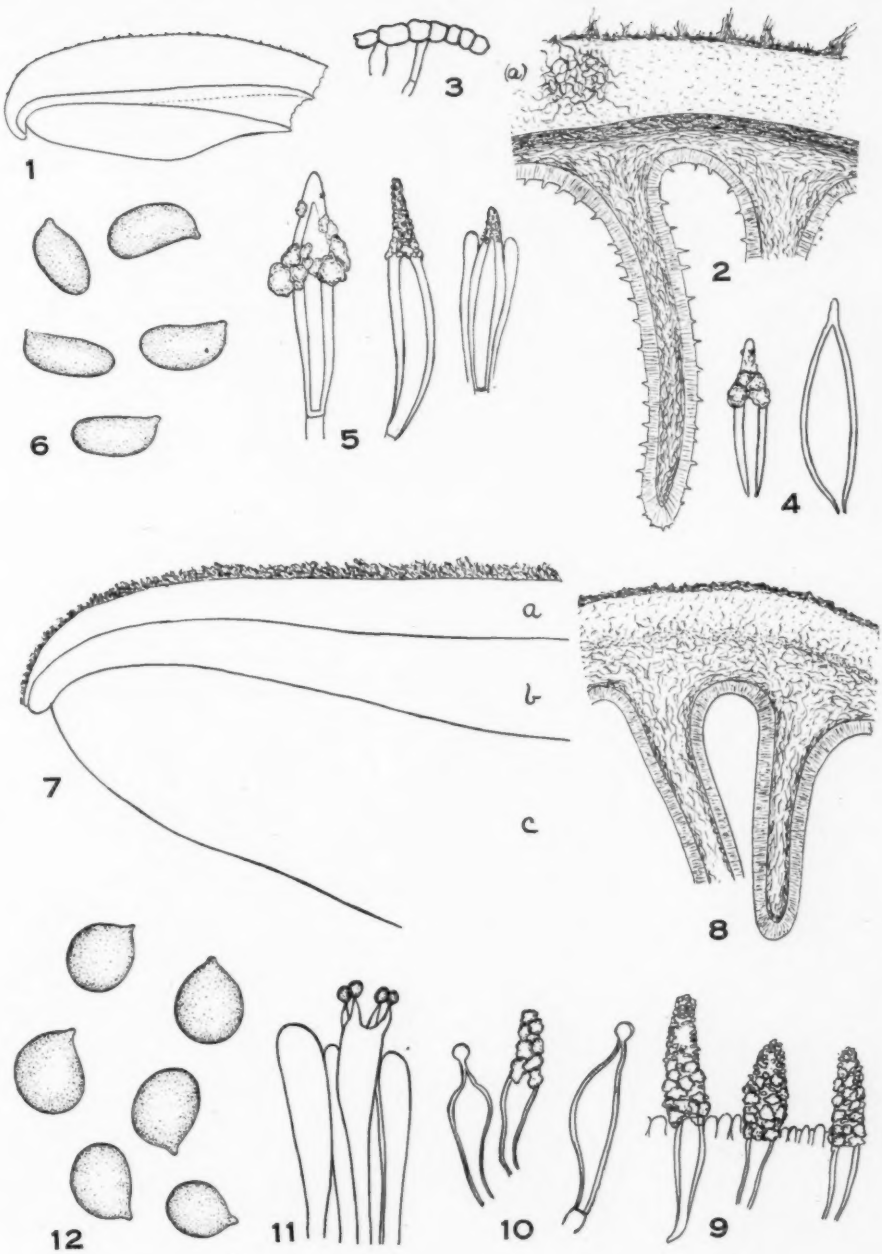


PLATE 48

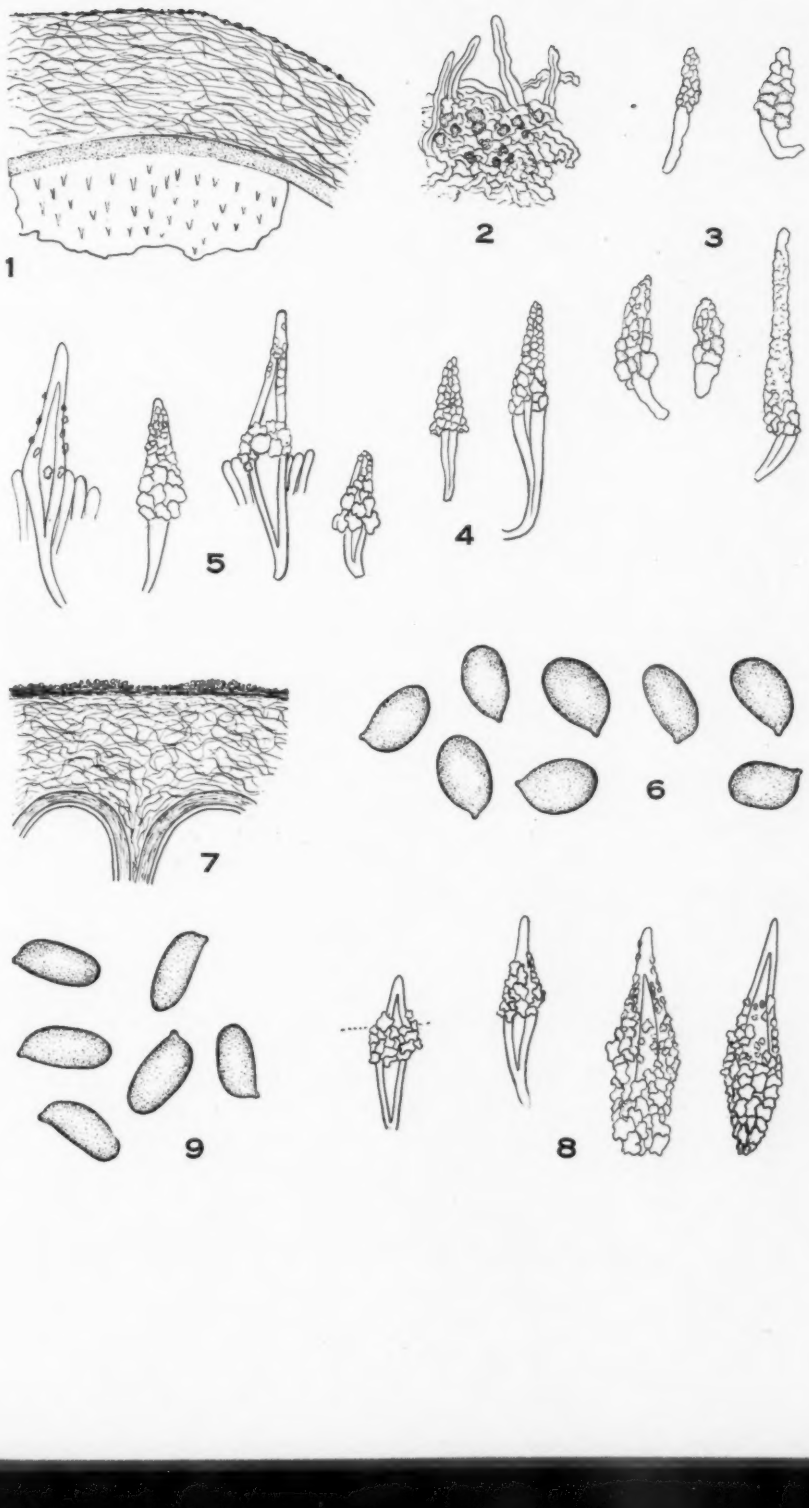


PLATE 49

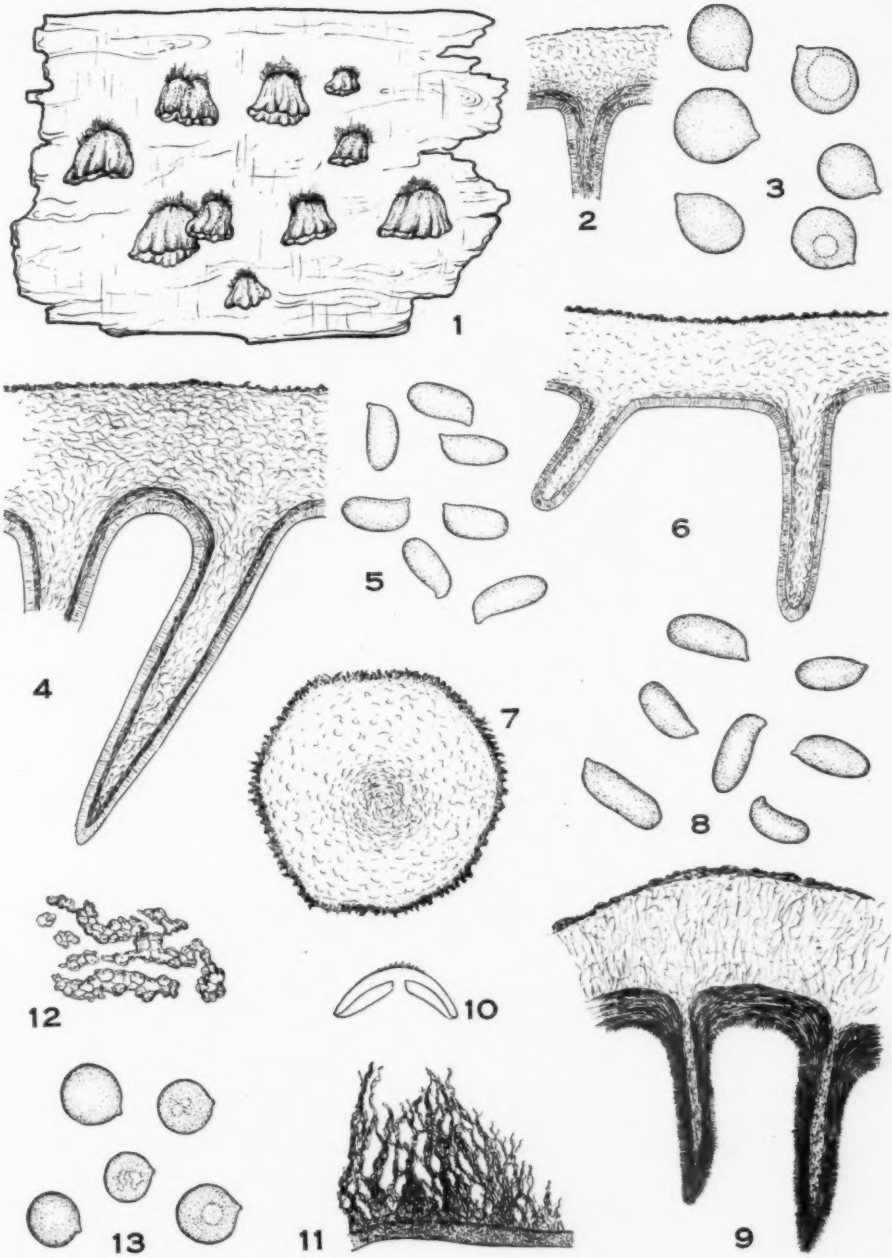


PLATE 50

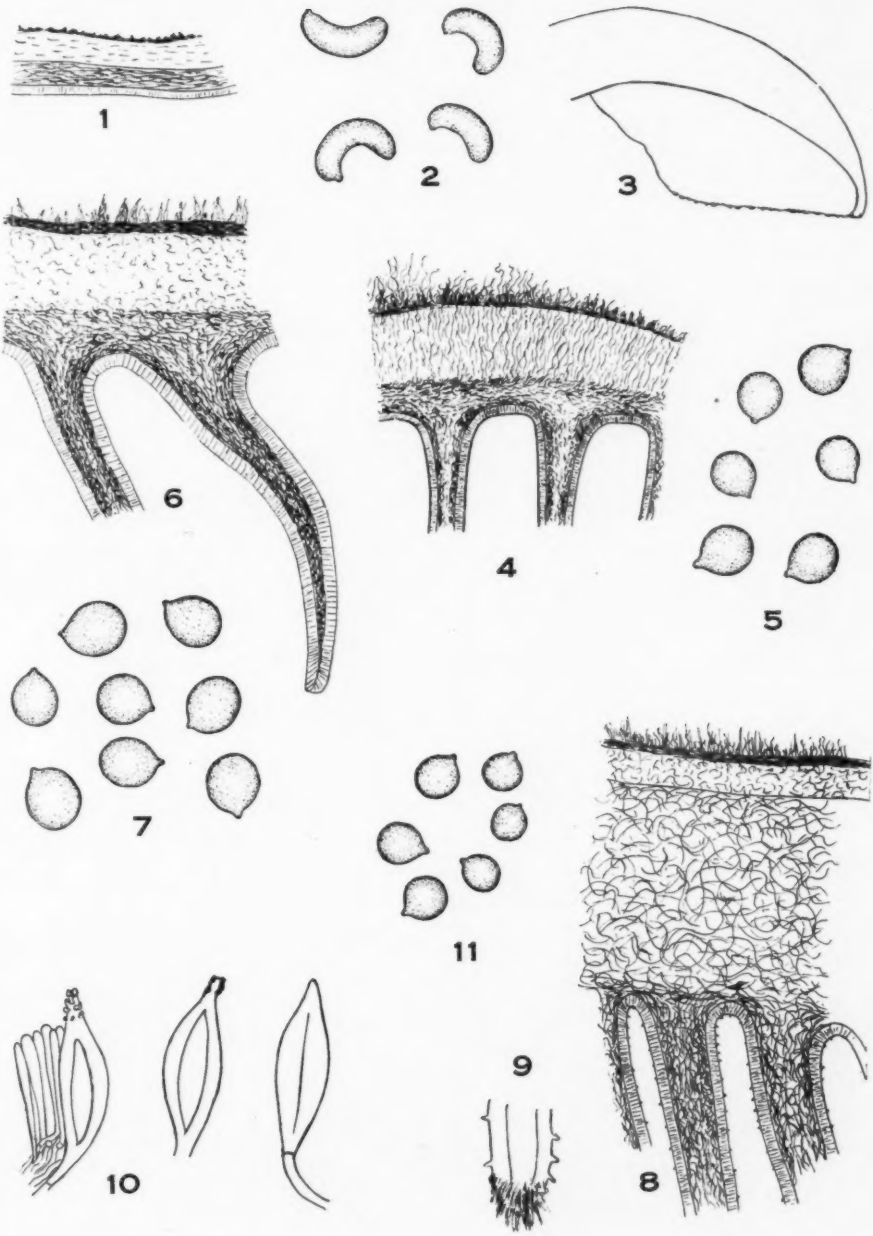


PLATE 51

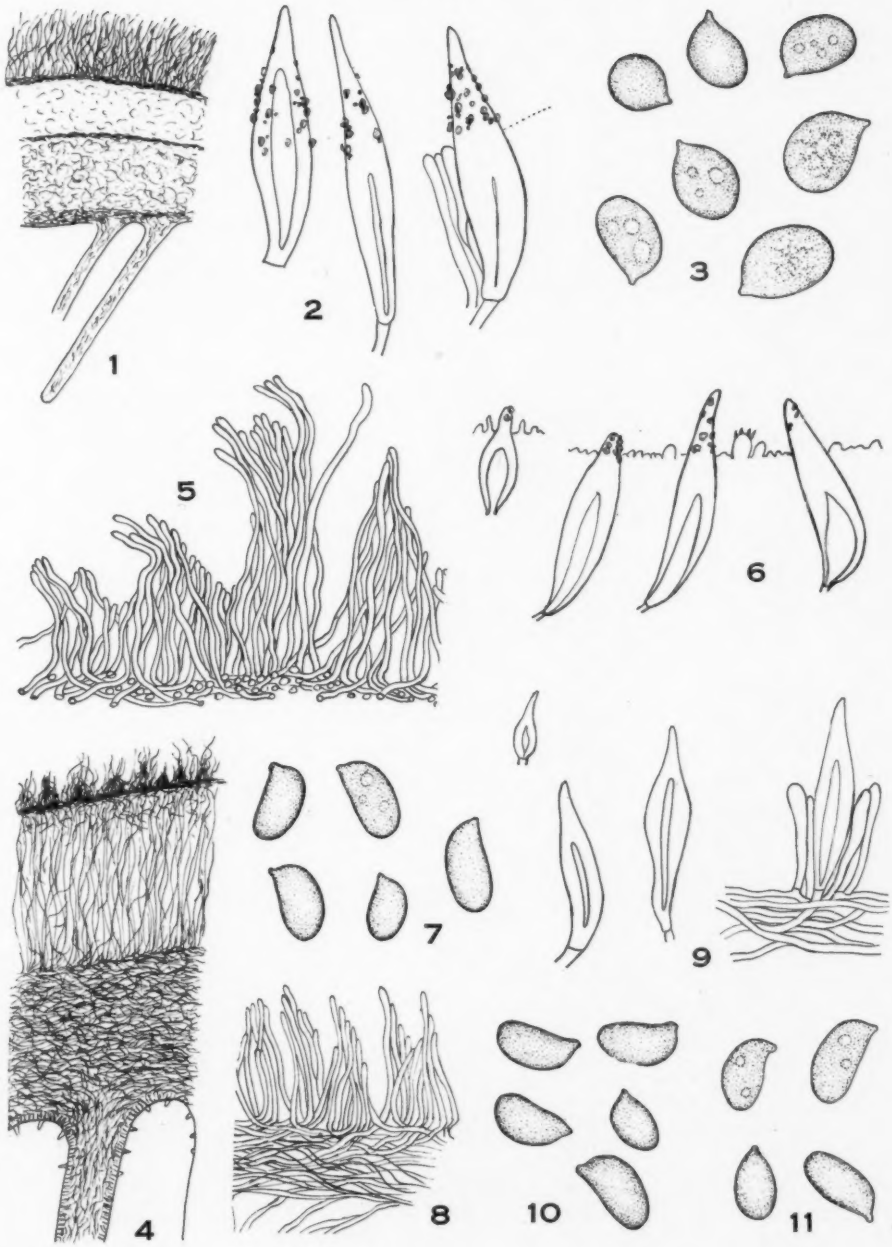
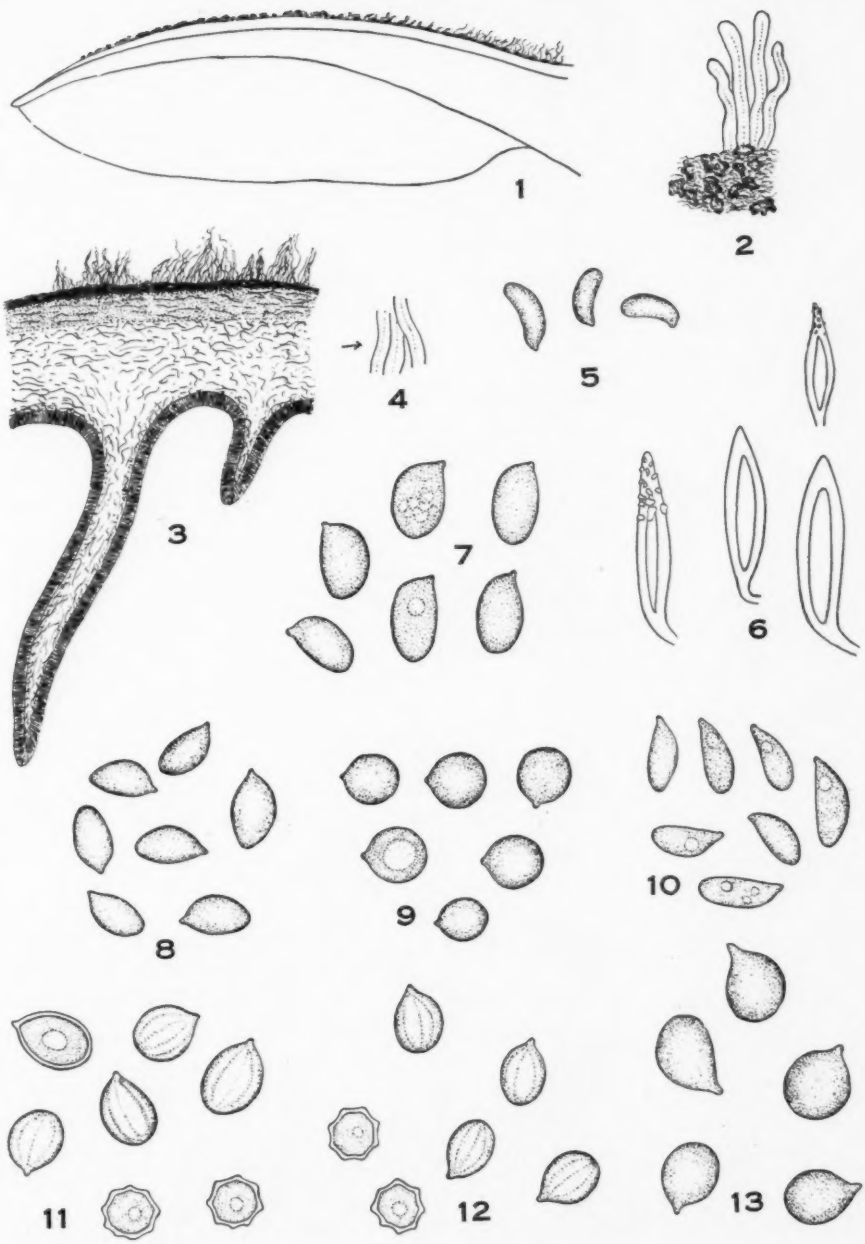


PLATE 52



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There are described under the genus *Boletus* sixty-eight species and six varieties. Of these, three species and four varieties are described as new. Four species of *Boletinus* and one of *Strobilomyces* are also included. Twenty species are illustrated in color and nearly all of the others by halftone photographs.

There are 96 pages of text; 6 colored plates; 55 halftone plates; and 5 plates of line drawings showing microscopic details. $7.00.

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